DOCUMENT RESUME

ED 264 848 IR 011 932

TITLE The Feasibility of Computer Networking in Education. A Study Submitted to the Thirteenth Session of the Alaska State Legislature.

INSTITUTION Alaska State Dept. of Education, Juneau. Office of Educational Technology and Telecommunications.

PUB DATE Jan 83

NOTE 118p.; For the proceedings of the Annual Alaska Small Schools Conference (4th, Anchorage, AK, December 3-5, 1984), see ED 257 600.

PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC05 Plus Postage.

DESCRIPTORS Change Strategies; Cost Estimates; Diffusion (Communication); Feasibility Studies; *Information Networks; Instructional Innovation; *Microcomputers; Program Implementation; State Departments of Education; State School District Relationship; *State Surveys; *Telecommunications; Use Studies

IDENTIFIERS *Alaska; Computer Networking Research; *Computer Uses in Education

ABSTRACT

A 4-month study was conducted to determine the feasibility and desirability of computer networks for instruction and educational administration in Alaska. Five major activities were carried out to collect the necessary information: (1) interviews with representatives of other Alaska government agencies; (2) a survey of district office staff; (3) a survey of a large sample of Alaska educators; (4) a meeting with representatives from state agencies and local districts; and (5) a review of technical information. Technical information gathered suggests that the hardware and software necessary to implement computer networking in Alaska education are, for the most part, currently available. Also, surveys and discussion with Alaska educators suggest they believe the quality of education in their localities could be enhanced by improved communications resulting from computer networking efforts. However, many educators were reluctant to expend limited local resources for electronic communications simply to enhance the timeliness of the information being sent, and ranked networking activities as less critical than several other educational computer areas. It was concluded that the Department of Education should conduct activities to investigate implementation of educational networks, but that this should not preclude providing support in other areas of educational technology. Appendices include copies of technical materials from the 1982 and 1983 Annual Alaska Small Schools Conferences. (JB)

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ED264848

A Study of the Feasibility of Computer Networking in Education

Submitted by the
Office of Educational Technology
and Telecommunications
Alaska Department of Education

Submitted to the
Thirteenth Session of the
Alaska State Legislature

January 1983

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A Study of the Feasibility of COMPUTER NETWORKING IN EDUCATION

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A Study of the Feasibility of COMPUTER NETWORKING IN EDUCATION

Submitted to the
Thirteenth Session of the Alaska State Legislature

by the
Office of Educational Technology and Telecommunications
Alaska Department of Education

Section 1
Executive Summary

A four-month investigation of the feasibility of computer networking in Alaska education has produced definitive results. Technical information gathered suggests that the hardware and software necessary for such networking is largely available. Further, substantial improvements in the practicality of such equipment for use in individual schools may occur within the next 18 months. Surveys conducted with a representative sample of Alaska educators also suggest that they believe the quality of education in their localities could be enhanced by improved communications such as might result from various computer networking efforts.

The enthusiasm of educators for networking was tempered, however, by two major findings of the study. First, the cost of electronic data transfer in Alaska is perceived as high. The study found many educators reluctant to expend limited local resources for electronic communications simply to enhance the timeliness of the message. Educators left the impression that networking systems, be they local or statewide, should be shown to be cost effective before they are implemented. Second, the educators, while advocating computer networking and expressing interest in its implementation, ranked networking activities as less critical than several other educational computer areas (e.g., acquisition of instructional and administrative hardware and software). The educators, however, were firm in their belief that using computer networking to support instruction was a valuable objective; it may be that they are simply not as technically informed about networking as other areas. The conclusion is that the Department of Education should conduct activities to investigate and support implementation of educational networks, but that such activities should not preclude providing support in other areas of educational technology.

Introduction

Senate Bill 719, enacted by the Twelfth Session of the Alaska State Legislature, directed the Department of Education to study the feasibility of computer networks for instruction and educational administration. Pursuant to that directive, the Department conducted a four-month project to determine the feasibility and desirability of such networking.

This Executive Summary gives an overview of the project activities and briefly presents the findings and recommendations offered by project staff. More detailed information, including supporting evidence for the recommendations, can be found in the full project report available from the Department.

Overview of the Project

The Department and its contractor conducted a number of activities during the short amount of time allotted for the feasibility study. Five major activities were carried out to collect the information necessary to determine the feasibility of educational networking in Alaska. First, project staff discussed the relationship between educational networking and other electronic communications systems in the state with representatives of other Alaska government agencies. Second, staff surveyed district office staff to determine their current level of computer use and expertise and their desires regarding the implementation of educational networks. Third, staff surveyed a large sample of Alaska educators (members of the Alaska Association for Computers in Education) about the importance of computer networking versus other potential uses for the Department's technological resources. Fourth, a meeting was held in which participants from state agencies and local districts discussed potential alternatives for educational networking. Finally, throughout the project, staff reviewed technical information on networking technologies and existing networking projects.

Each of these activities yielded valuable information which influences the feasibility and desirability of computer networking in education. Taken as a whole, the information collected gives some important clues to the potential role of networking in Alaska's schools and district offices.

Findings of the Project

This section lists some of the most important findings of the study. More detailed information is given in the project Technical Report.

From the discussions with other State agencies

- o The Department of Administration is engaged in planning the implementation of a statewide communications system which will be available to local educators and will greatly enhance the educators' ability to communicate among themselves.

- o The new State system will not be ready as quickly as needed to answer some specialized concerns of state educators.

- o While the Department of Education need not be responsible for a long-term statewide solution to electronics communications problems among remote sites, it should take responsibility for suggesting low-cost interim procedures which will facilitate communications until an optimum statewide system is placed into operation.

From the survey of district capability and plans

- o One out of four school district offices and a somewhat higher percentage of school buildings report at least occasional reliability problems with their telephone communications which might hamper their participation in a computer network.

- o Most districts and schools have personnel with sufficient technical training to participate in a computer network.

- o Most districts do not have all the resources they would like to spend for instructional and administrative small computers.

- o It is very difficult for local educators to keep abreast of developments in educational computing.

- o Respondents feel strongly that better communications would improve the quality of education in their district.

- o Of the total amount of information transferred, the relative percentage of information transferred from schools to district, from district to school, from district to state agency, from state agency to district, etc. would be affected little by the implementation of electronic communications systems. There may, however, be increases in the overall amount of information transferred.

From the survey of the preferences of local educators

- o Obtaining instructional software, receiving staff training in computers and computer use, and obtaining computer hardware for instructional use are three critical needs of Alaska's local educators.

- o The ability to transfer data by computer among schools, district offices and State agencies is of much lower priority than some other uses for the limited resources the Department has available to implement educational technology in Alaska schools.

From the review of alternatives by conference participants

- o There are numerous potentially valuable applications for an educational computer network, but the eventual use of the network will be determined by cost.
- o Few districts have sufficient information to know the full range of benefits that might be produced by a computer network.
- o Few districts have a trained person who is formally responsible for planning and implementing technological changes in the district.
- o There is interest in the improvement of the existing Electronic Mail System and its extension to each school building, but there is also uncertainty about at the district and school level about all the advantages such an expansion might provide.

From the technical review of networking hardware, software and projects

- o Sufficiently refined hardware is available for educational networking in Alaska's schools, but the cost and quality of the telephone lines for data transfer remains a problem.
- o Costs of the hardware and software necessary to bring a user with good phone service into a preexisting network will generally be $500-$1500; operating costs will make the amount substantially higher. This cost is high enough that users will have to be convinced of the value of the network before they will participate.
- o There is little applications software available to be used by participants in an educational network.
- o There is precedent (from other state and local education agencies) for the establishment of statewide computer networks to assist educational computing and data transfer.

Recommendations Derived from the Study

The information collected from the feasibility study suggests several recommendations about the future direction of computer networking in Alaska education. Additional explanation of these recommendations is provided in the Technical Report.

1. The Department of Education should provide local educators with more information about the potential benefits of educational networking.
2. The Department should assist school districts in implementing educational networks by providing technical information and training of staff as needed.

3. Resources should be provided for the Department to work with interested districts to establish a few pilot locations for different types of educational networking and to evaluate the value of the networking process. Information on the pilot investigations should be widely disseminated to Alaska educators.

4. Work on educational networking should be in addition to, rather than a replacement for, any of the Department's responsibilities for providing training, instructional software, etc., to Alaska schools.

5. The costs associated with the purchase of hardware for computer networking should be the responsibility of the individual district implementing the network. The Department should attempt to gather information on the process used by the district to determine the expected benefits of the system.

6. Resources should be allocated to a study of the configuration and potential uses of a statewide educational computer network of the type that will become possible with the implementation of a statewide data communications system. Department staff should begin immediately to provide this type of information to the Department of Administration for use in their planning process.

7. The Department should establish a means to periodically discuss with districts the capabilities of and techniques for using the existing Electronic Mail System and the potential benefits that might accrue from expanding this system to the school level.

8. The Department should assign a staff member or contractor to follow developments in networking and report periodically to the districts and the Legislature on any technological innovations which might affect the feasibility of computer networking among Alaska's educators and students.

Each of the eight recommendations above relates to a need which the feasibility study showed to be important to improving communications among educational agencies in Alaska. Whether implementing these recommendations is an advisable course cannot be determined until their value is examined in comparison with other needs that require Department resources.

Conclusion

The study of the feasibility of computer networking in education commissioned by the Alaska Legislature obtained important information regarding how networking might improve Alaska education. A number of data collection activities associated with the study suggested that computer networking was both feasible and desirable. Therefore, additional development of the area by staff of the Department of Education has been recommended.

Because the cost of implementing and using computer networks is substantial, it is difficult to predict whether a computer network will be cost effective in any given situation. The Department of Education's Office of Educational Technology and Telecommunications, however, has access to the information necessary to determine the cost-benefit relationship of different networking alternatives. Therefore, providing technical assistance on networking to Alaska school districts will be one of the Department's most important activities to enhance the feasibility of the networks and is strongly recommended.

Section 2
Background Information on the Feasibility Study

This section of the Technical Report discusses important information about the procedures used during the feasibility study. It also presents technical information about computer networking in general, and educational applications of networking in particular. Finally, the results of the study's data collection activities are presented.

Introduction

There have been few organized efforts to determine the feasibility and usefulness of computer networking in education. The majority of the educational networking projects which have been conducted to date deal only with the value and practicality of networking in an individual school or school district. Also, many of the educational computer networks that are in place are based on large computers which are rarely cost effective for educational agencies with small enrollments.

In specifying that the Department of Education should conduct a study of the feasibility and costs of computer networking for Alaska education, the State Legislature set in motion one of very few examinations of how networking applies to the full range of educational levels—classroom through statewide system. Further, the Legislature's requirements that the study focus on the use of small computers by a wide range of educators and community members also separated it from the complicated approaches often taken by educational data processing personnel. In short, the study required by the Legislature required new ground to be broken in investigating a variety of networking approaches to determine how they might assist Alaska education.

Some of the conclusions of the study are subjective, having been based on the potential of computer networking in education. The majority, however, are the result of collection of objective data about the needs and preferences of potential educational users and technical information about networking. This section of the report presents the information needed to support the conclusions, recommendations and suggested networking alternatives discussed in the following sections.

Computer Networking in Education

There are two major reasons for the use of computer networks in education. The first is to facilitate the transfer of information between computers in various locations. The second is to provide a means of sharing mass storage and input/output peripherals among several computers, thus resulting in increased capability at a decreased cost. These two advantages can benefit a wide variety of educational settings in Alaska. Networks can be established among the computers in a classroom, the classrooms in a school, the schools in a district and the districts within the state.

Indeed, these two concepts—transferring information and sharing hardware—are the key elements of a definition of networking. Unfortunately, it is scarcely worth the time to try to formulate a precise definition of computer networking because such a definition would give no guidance on the scope of the network. Two Apple computers sharing a printer constitute a computer network, as does the United States telephone system. It is therefore best not to worry about a precise definition for computer networking; virtually any method of electronic information transfer qualifies.

There is also the question of the distance between the stations of a network and the method—principally through either cables or the telephone system—of passing the signal. When the stations of a network are in the same building, they can be connected by cables. This creates a "local" network. Local networks are the type referred to in discussions about in-school networking. When the stations are too separated to be connected by cables, a "remote" network is established. Remote networks are the type referred to in discussions of networking between schools and district offices, and between district offices and state agencies. Some of the statements about the feasibility of educational networking apply to both local and remote networks; when the discussions make no distinction, they usually pertain to both types.

Even though almost any electronic information transfer would be considered a network, how educators can best make use of the potential of networks is not an easy question. Alaska has always been viewed as one of the pioneers in educational

technology. The Department's Educational Telecommunications in Alaska (ETA) Project and its associated Electronic Mail System (EMS) remain a unique contribution to educational technology; they continue, after five years, to garner favorable publicity for the state. Alaska's school districts lead the nation in the number of microcomputers per student; Alaska's educators are more sophisticated about and better trained in the use of microcomputers than any equivalent group in the country. But in spite of being leaders in educational technology, dramatic advances in microcomputer hardware and networking technology have left Alaska short of the state of the art in sharing resources and information across computers.

Two years ago, the Department of Education's Office of Educational Technology and Telecommunications took some initial steps to investigate the role of computer networking in education through it Innovative Technology in Education (InTech) Project. In the summary technical report of that project which outlined promising areas for future investigations, project staff wrote that ". . . the ability to cost-effectively network microcomputers may be the single greatest factor in determining the success of the computer in educational settings." A "Report Card" developed by the InTech staff to show the promise of various innovative technologies in education gave "small computer networks" an A for potential benefits and an A- for likelihood of successful implementation.

This theme was reiterated in a January 1982 InTech staff memorandum which stated, in part:

> While the price of computer hardware is declining, it is unlikely that it will drop low enough in the next decade to allow a stand-alone computer with associated peripherals to be purchased for everyone who would benefit from one. (Printers, keyboards, display screens, disk drives and so on are not subject to the same dramatic price decreases as memory and processor chips.) In addition, stand-alone computers have no good means of accessing data from local "communal" data bases. Thus, connecting user stations together in a local network would both increase the utility of the system to the user and increase the number of potential users by decreasing the per user costs.

Department staff are not alone in their enthusiasm for this type of networking. The well-regarded research firm Strategic, Inc., recently released their report Impact of Personal Computer Local Area Networks. The study found that there are approximately 12,000 "personal computer networks" in place, but predicted that the figure will increase

to over 110,000 by 1987. The report also predicts that the percent of business and educational computers connected to networks will increase from 4 to 17 percent in the next five years. The report concluded that "the cost of network interfaces will drop so fast that network hardware will be a negligible part of system cost." Whether these predictions will be realized is still at issue, but virtually every observer of the progress of computers expects networks to play a vastly increased role in the next few years.

Studies conducted by those responsible for planning and implementing small computer networking systems have continually reported networking of small computers to be profitable, with surprisingly short payback periods for the equipment. The first successful installations have generated more interest from manufacturers, who in turn have produced better equipment which suits the needs of more users. In what might be considered a positive application of the "chicken and egg" principle, the variety of networks has grown dramatically; "Local Net Offerings Mounting to Fever Pitch" was how the trade publication Computerworld expressed the growth. Further, the fact that the first product of the Bell System's new American Bell subsidiary should be a computer network (Advanced Information Systems/Net 1000) is another indication of the potential of networking. There is no question that the Alaska Legislature selected a most pertinent area for study.

This is not to say that the implementation of networks is without problems. There are only slightly fewer incompatible networking systems than there are manufacturers of networking equipment. Protocols for the transfer of data are important; there is virtually no chance of matching incompatible equipment in a post-hoc modification. Although various professional committees have been charged with developing a standard for networks, it is generally felt that they will be forced to develop multiple standards and that even these standards will likely not be followed. The immediate need to make networks available to prospective users has made it impossible for the standard-setting process to have an impact. This lack of standards means that the state's educational agencies will not end up with compatible network systems unless some influence is exerted by the Department of Education or some other State agency to ensure that compatibility problems are minimized.

Nevertheless, there seems to be little doubt that small computer networking is both practical and effective. Recent studies found as many as 97 percent of those recently implementing local networks view their installations positively, stating that

they were glad they had been installed. Since small computer networking both lowers costs and increases capability, carefully conceived installations become no-lose situations.

There are, however, no clear models for how to best bring the benefits of computer networks to educators. While there have been educational networks in existence for over twenty years, the cost of computer equipment has, until recently, limited cost effective networking to a few special situations. The advent of the microcomputer changed cost-benefit relationships for schools. But for the past few years, educators have had their hands full simply becoming acquainted with the potential of the microcomputer and learning how to use it in relatively simple applications. Only recently have educators become familiar enough with this new tool to investigate more advanced concepts such as networking.

Throughout this report, reference will be made to promising equipment and techniques which might contribute to a statewide plan for educational networking. Many of the pieces needed for educational networking are ready to be adopted for use by Alaska educators. But the diversity of Alaska's school districts, particularly in enrollment and geography, makes it difficult to find existing systems which are guaranteed to be practical and cost effective for all districts. In short, there are no good models for the State to follow in implementing widespread small computer networking. But such models will be forthcoming in the next few years as educators throughout the country recognize the benefits of networking. Determining whether Alaska should assume a pioneering role in this area will require a careful balancing of the available benefits of such systems with the resources available.

An Overview of the Study

The Department (with the assistance of its contractor, Interwest Applied Research) conducted a number of data collection activities during the course of the project. The Department tried to collect enough data so that the conclusions and recommendations made to the Legislature were as objective as possible. This is in keeping with Office of Educational Technology and Telecommunications procedures which call for the input of potential users in all planning and development projects.

Five techniques were used to obtain the information necessary to determine the potential of computer networking for Alaska education. The techniques, which were carried out concurrently, were as follows:

1. Project staff discussed the relationship between educational networking and other electronic communications systems in the state with representatives of other Alaska government agencies.

2. Project staff surveyed the computer coordinators of Alaska's school districts to determine their districts' current level of computer use and their desires regarding the implementation of educational networks. The survey also collected information on the computer equipment the districts have which might be used in networking, and the expertise of district staff related to the tasks necessary to implement an educational network.

3. Project staff surveyed a large sample of Alaska educators who are potential users of an educational computing network about the importance of the network versus other potential uses for the Department's technological resources.

4. A meeting was held in which participants from state agencies and local school districts discussed potential alternatives for educational networking.

5. Throughout the project, staff reviewed technical information on networking technologies and existing networking projects.

In considering the feasibility of computer networking for Alaska education, decision makers need to study a complicated interaction among three elements—the availability of practical networking equipment, the educational benefits that might derive from networking, and the cost of implementing and using a network. None of the three can be considered in isolation. For example, until reliable, easy-to-use network interface hardware became available, an educational network could not be implemented regardless of the potential benefits. But, on the other hand, if there are few potential benefits from networking, advances in the quality of networking hardware matter little. Perhaps most important is the realization that there is no way to say educational networking is or is not a good idea. A comparison needs to be made between costs for the system versus the value of the problem solved by the network. It is obviously difficult to assign a dollar value to, say, providing a student in rural Alaska with access to otherwise inaccessible research information. But that is precisely what must be done before the value of the network can be determined.

The focus of the feasibility study's data collection activities was to obtain the information available related to each of the three elements described above. Sufficient data was collected to allow project staff to make generalized statements about the interaction of the three elements. However, the data collected also suggests that the benefits that could be obtained from computer networking vary across locations. Readers, therefore, should remember that the alternatives, conclusions and recommendations derived from the data may not apply to any individual district or school but are valid for the state as a whole.

Study Procedures

As mentioned above, five independent data collection techniques were used to collect the information necessary for this feasibility study. Different procedures were used for each of the techniques, as described below.

Information from State Agencies

Both the Department of Education and the Legislature recognized the need to view the networking feasibility study from the broad perspective of statewide data communications, not just from the narrower educational perspective. Obviously, any statewide telecommunications network which meets the needs of educators would also serve many other statewide communications needs. The converse is also true; if other agencies plan on developing a statewide network, it may be advantageous for the Department to use that system rather than developing its own. The Legislature's charge to the Department to discuss networking plans with other State agencies was therefore taken very seriously.

The Alaska State Government has given major responsibilities for statewide telecommunications to the Department of Administration and its Division of Telecommunication Services. One of the first activities of project staff was to meet with representatives of this division to discuss the feasibility study and determine what plans they had for implementing statewide networks. Project staff met with Department of Administration staff several more times throughout the study. During these discussions, project staff gained an insight into not only the plans they

had, but the potential telecommunications needs of other agencies such as the Department of Fish and Game, the University of Alaska and the Legislature itself.

Surveying School Districts Regarding Capability and Plans

One of the most important steps in determining the feasibility of computer networking in Alaska education is to find out how prepared for and interested in networking schools and districts are. Thus, the Department's activities included a special survey sent to the person designated as the Computer Coordinator in each of Alaska's school districts.

Before any actions were taken toward conducting a survey of districts regarding current computer access and capability, staff explored what part of the desired information was already available. It turned out that other projects had gathered some information (particularly information related to the telecommunications equipment located at each site), but that data on how prepared Alaska's districts were to participate in computer networking did not exist. But the review of the existing data permitted the data collection instrument developed by project staff to be reasonably brief.

Content of the questionnaire was determined following examination of existing data and discussions among project staff. The instrument sent to the district consisted of three major sections:

- o A section about equipment and capability. This section asked for information about the number and type of computers, modems and printers available at both the district office and the "typical" school building in the school district, the number of telephone lines available and whether any of the lines were readily available for telecommunications use, the expertise of district and school staff to use telecommunications equipment, and other technical issues.
- o A section about the plans and preferences of school district staff regarding computer use and telecommunications. Respondents were asked the importance of various benefits that could be derived from use of small computers and telecommunications, the amount of assistance they would like from the Department of Education, and their plans for future use of small computers.
- o A section which asked for the relative amount of district information transfer among various sources and destinations. The task was completed twice by respondents: once to reflect their current situation and once to reflect how they thought information might be transferred were an economical, easy-to-use electronic communications system available to them for routine use.

A copy of the questionnaire used in this survey is included in the Appendix to this Technical Report.

Surveying Users on Relative Importance of Network Systems

Before the feasibility of educational computer networking systems could be established, it was necessary to find out how important the ability to communicate electronically was to Alaska educators. This presented an interesting problem in survey research. Generally, if you ask a potential user to tell you how much they would like to have access to a particular innovation, they will say they would very much like to have it. The assumption on the part of respondents is that they have nothing to lose; after all, they have nothing at risk in inviting the Department of Education to spend Department money to develop and implement the system. If it is a success, good; if not, it is no loss to the potential user.

Various research reports have described the problems with using questionnaires in which respondents use a four- or five-point scale to indicate their interest in participating in innovations. Respondents tend to support the proposal without recognizing that the organization conducting the survey can't engage in all the available options simultaneously. They fail to realize that implementing a given project means that some other project might not get carried out because of a lack of resources.

Research has shown that using a paired choice questionnaire results in significantly greater discrimination by respondents. In a paired choice questionnaire, each available option is presented paired with every other option. As an example, suppose a person were asked to show their preference for red, blue and yellow. A common type of questionnaire might look like this:

	Strongly Agree	Agree	Disagree	Strongly Disagree
	(Circle one for each color)			
I like the color red.	SA	A	D	SD
I like the color blue.	SA	A	D	SD
I like the color yellow.	SA	A	D	SD

In comparison, a paired choice questionnaire would look like this:

DIRECTIONS: Place a check before the sentence from each pair that you agree with more.

( ) I like the color red.
( ) I like the color blue.

( ) I like the color blue.
( ) I like the color yellow.

( ) I like the color yellow.
( ) I like the color red.

The advantage to this paired choice questionnaire is that respondents must make a decision; they can't agree with everything. This is very important in a feasibility study because resources are usually limited and everything can't be done. Desired characteristics have to be prioritized in order to determine costs and benefits of the most-desired options. Hence, the Department's survey asked potential network users to express their preferences regarding implementing computer networking versus a variety of other types of assistance the Department could provide.

In the instrument, respondents compared three types of computer networks to six other types of educational technology with which the Department might assist. Pairs from the questionnaire included:

1a. Transfer information by computer among schools/district offices statewide.
1b. Obtain microcomputer hardware for administrative use.

2a. Transfer information by computer between schools and district offices.
2b. Receive more staff training in computers and computer use.

3a. Obtain computer software for instructional use.
3b. Transfer information by computer between the State and schools/districts.

The paired choice questionnaire was mailed to a large sample of potential network users in the educational community. A sample of this questionnaire is included in the Appendix.

Educational Networking Conference

Following the preferred techniques used when considering the implementation of any innovation, the Department sought the comments of some of the state educators

and state government personnel who might be potential leaders in the use of any networking system that the Department might propose. The involvement of a group of knowledgeable professionals in interpreting survey results and offering feedback on the feasibility of various alternatives provided a valuable review. Such discussions help ensure that the strategies for computer networking that the Department considers are, in fact, viable for actual use. Further, by involving key leaders in the decision making, their support for any subsequent Department decisions will likely be increased. Thus, the meeting of these participants was viewed as an extremely important part of the overall feasibility study.

The conference was held in Anchorage in early December so that it coincided with the Alaska Small Schools Conference. The conference was divided into morning and afternoon sessions. The morning session was open to all attendees at the Small Schools Conference, although a number of individuals received special invitations to participate. The afternoon session was by invitation only. Both sessions were well attended. The morning session was the more structured; presentations by project staff discussed the study and presented some information on networking strategies. Participants then spent time in small group sessions where they provided project staff with a wide range of potential uses for a computer network. An agenda for this session is included in the Appendix, as is a copy of the discussion guide used in the small group sessions. Participants in the conference received a booklet containing specifications for a selection of networking equipment; a copy of this booklet is also included in the Appendix.

Most of the time in the afternoon session was spent reviewing the potential benefits to be derived from implementing networks in Alaska. There was considerable discussion about the benefits and limitations of the Department's existing Electronic Mail System, as well as discussions about the best equipment to use to connect computer users in a local setting to a network. There was also consideration of what personnel within a district should be responsible for implementing a networking system. In short, the project staff gained a great deal of important information from participants about the realities of current and potential computer use in the schools and districts in the state.

Review of Technical Information

While project staff were collecting data from Alaska educators, they were also collecting technical information about the hardware and software necessary to implement networks for Alaska education. The time allocated for the feasibility study was brief, but as mentioned earlier, Department staff began their consideration of educational networks several months earlier. Further, the timing of the study was fortunate in that significant advances in the ability of microcomputers to participate in large-scale networks took place during the course of the study.

There was also a big increase in the interest computer users showed in networking. This interest, in turn, caused those providing networking services and software to expand their offerings. As an example, when the study began there were less than five well-constructed programs to transfer files between Apple II computers in remote locations. Six months later, the number has more than tripled. The number of readily accessible data bases containing information of interest to educators has also grown. Further, project staff have no doubt that the growth in networking hardware, software and services will continue to grow dramatically. And as the sophistication of networking components increases, the number of cost-effective applications in Alaska education also increases.

It is not useful in this report to detail all of the technical information available as a result of the feasibility study. As mentioned above, the increased interest in computer networking brings a constant stream of new developments. Project staff have access to information on a wide variety of technical information, including:

- o Star, ring (also called loop) and bus network topography
- o Baseband and broadband network systems and the comparative advantages of each for use in Alaska schools
- o Slow speed (less than 2 Mbit/sec) coaxial and twisted pair networks such as those commonly used in educational in-building networking (e.g., Corvus Constellation and Omninet, Nestar Cluster/One, CPU Computers CPUnet)
- o Use of networking for combined voice and data transfer and the potential for video transmission
- o Microcomputer-to-mini/mainframe computer communications packages

- The structure and potential utility of such quasi-networks as The Source, Compuserve, and the Dow Jones Retrieval System; computer-based message services such as Infomail, Telemail, and Ontyme; time sharing services such as Boeing Computer Services, General Electric Information Services, and Tymshare; and data base providers and sources such as Lockheed Dialog, the Educational Resources Information Center, and the School Practices Information Network.

Earlier in this report, it was mentioned that there were not good models of educational networking which the State could simply adopt. In the course of collecting technical information, project staff did find a number of successful educational networking systems. While they are not suitable as complete models, each offers elements that might be of use to a potential Alaska system. Examples include:

- The Ohio Department of Education's statewide educational computing network which has established regional service centers and common software packages for use by local districts.

- The American College's Service Calvados—France's first national microcomputer network—which will eventually link thousands of Apples to its Harris H500 supermini computer.

- The U.S. Military Academy's Instructional Support System, a Sytek LocalNet installation with a capacity of up to 20,000 terminals.

- The proctor/student and registration networks established at Mexico's Monterrey Institute of Technology.

- The Kamehameha Schools' (Honolulu) NCR-based distributed processing system which can link up to 256 campus terminals for educational administration or instructional purposes.

- The joint BBC/Brighton Polytechnic Research Project on the educational application of videotext networks in Britain's secondary schools.

- Brown University's campuswide network of administrator and student terminals, currently the largest such installation in the country.

Also of interest was the decision, made during the course of the project, by three universities to require students to purchase microcomputers for use in a campuswide network. While the project staff would not suggest that these networks have much applicability to the Alaska schools, the decision to mandate student computer use will increase the likelihood of vendors developing low-cost networking components.

The type and amount of information collected by project staff is not of particular importance; the field is changing so rapidly that much of the data becomes obsolete very rapidly. (As an example, as this report was being written, Apple Computer announced its decision to support the Ethernet networking system on its current and future microcomputers. Such an announcement substantially alters the practicality of Ethernet systems for local educational use.) But since new improvements make networking feasible in a wider variety of settings, the need for continued collection of technical information is one of the clearest conclusions to be drawn from this feasibility study.

Results of the Data Collection

As noted, there were five major data sources in this feasibility study: discussions with representatives from other State agencies, a survey of representatives from each district office, a survey of knowledgable educators who are potential users of a networking system, a conference of selected State agency and district representatives, and a technical review of information related to networking hardware, software and projects. Results from the first four data sources are presented in this section; the technical information collected is discussed in the following section and referenced throughout this report.

Discussions with Other State Agencies

Early in the feasibility study, it was learned that the Department of Administration is engaged in planning the implementation of a new statewide communications system. This system, which is several years away from full implementation, will be available to local educators and will greatly enhance educators' ability to communicate among themselves. But educators have some immediate needs which could be alleviated by networking, and the delay in development of the State's new system will cause hardships. Therefore, the consensus from the discussions with staff from the Department of Administration was that the Department of Education should not be responsible for a long-term statewide solution to electronic communications problems, but it should take responsibility for

suggesting low-cost interim procedures which will facilitate electronic communications until an optimum statewide system is operational.

School District Survey

A copy of the survey with average responses included is provided in the Appendix to this report. Highlights of the results are described below.

In the section related to current district and "representative school building" computer capability, it was learned that the average Alaska district office has six telephone lines and the average school has two telephone lines. Whereas about a quarter of the respondents said that at least one district office telephone line was mostly unused, only six percent of the respondents said the same thing about a local building phone line. This finding is important because, for all practical purposes, every type of network except an in-building network requires the use of a phone line for transferring information. While the majority of respondents considered the telephone service reliable, respondents said that 59 percent of district office telephones and 69 percent of local building telephones experience problems of "breakup" or "echo" of telephone signals. This, of course, would cause problems if information other than voice signals were being transferred via the phone line; if the phone line broke up while data were being transferred from one computer to another in a network, some of the data would be lost.

At least 60 percent, and in some cases up to 90 percent, of the respondents said that there were staff members in both the district office and the local building who can use a modem to send a computer message, perform simple maintenance of computer equipment, and understand computer terms such as parity, stop bit, and baud rate. Thus, it does not appear that lack of technical expertise would be a major inhibitor to having districts and schools participate in a computer network.

When asked if there were a central computer in the district that serves district-wide functions and if the district uses external computing services, 63 percent of the respondents answered yes to the first question and 58 percent

answered yes to the second question. These figures are important because they indicate that there are already computers (frequently the Electronic Mail System's GNAT computer) with which other computers in the district could interact if networks were available.

The second section of the questionnaire asked respondents to express their degree of agreement with a number of statements about current computer activities and future plans. Of particular importance to the feasibility study were the following four statements:

- o If we could send messages via computer to schools and district offices statewide, we would do so.
- o Any computer network must allow students to be able to send messages to other schools in the state.
- o Better communications (district and statewide) would improve educational quality in our district.
- o Our district makes good use of the existing Electronic Mail System (EMS).

Respondents expressed agreement with these statements, but in declining strength. On a five-point scale where 1 is Strongly Agree, 2 is Disagree, 3 is Neutral, 4 is Agree and 5 is Strongly Agree, the average responses for the four statements were 4.50, 4.33, 4.14 and 3.75, respectively.

Also important was the lack of agreement with the following three statements included in the questionnaire:

- o We have sufficient resources (staff and money) for any computerized instructional system we need.
- o We have sufficient resources (staff and money) for any computerized administrative system we need.
- o It is easy for district staff to keep up on the latest developments in educational computing.

Average responses, using the same five-point scale, were 2.27, 2.05 and 1.82, respectively. These responses are important to remember and contribute directly to recommendations made as a result of this feasibility study.

The third section of the questionnaire asked respondents to compare the amount of information they currently transfer by any means available (telephone, U. S. Postal Service, intra-district mail, EMS, etc.) with the amount they would like to transfer if cost or technical factors did not restrict information transfer. The two sets of responses (current and ideal amount of information transfer) were very similar. Hence, it can be concluded that the distribution of the information transferred between schools, district offices and state agencies would be affected very little by the implementation of electronic communications systems.

Survey of State Educators

As described in the Study Procedures section of this report, the questionnaire sent to educators who are members of the Alaska Association for Computers in Education forced them to prioritize several computer-related actions. Results from the survey indicated that the ability to transfer data by computer among schools, district offices and State agencies is of much lower priority than some other uses—specifically, the ability to obtain instructional software, receive staff training in computers and computer use, and obtain computer hardware for instructional use. Assuming that the Department has limited resources available to implement educational technology in Alaska schools, the preferences expressed by AACE members would clearly indicate that computer networking is not at the top of the list for what those resources should buy. However, as discussed later, there is little indication AACE members are aware of the benefits a statewide network might bring. Thus, the true value of these findings must be considered carefully.

Conference Results

Conference participants found it easy to identify numerous potentially valuable applications for an educational computer network. Some of the suggested applications served administrative needs—the transfer of student records, financial reports, attendance, inventory control, changes in State regulations, etc. Other uses were more curricular: staff development information, resource availability (people and materials), research updates, career planning information, current events. Some suggestions were quite unique: computerized chess tournaments, debate tournaments or "Think Bowl" games carried on by students hundreds of miles apart; coordinated

student government activities (e.g., assemblies, dances) so that more than one school might take advantage of guest speakers, bands, etc.; joint research projects conducted by students in different locations; pen pals to encourage and improve writing skills; and many more.

Although there is no problem identifying such uses, conference participants made it clear that eventual use of any network would be determined by its cost. They admitted that few districts have sufficient information to know the full range of benefits that might result from access to a computer network. Even the existing Electronic Mail System, a network that already exists, is not viewed as being currently used to its fullest potential—not because school districts don't want to use the EMS, but because they do not have a complete idea of all uses for which it could be used in education. But even as it is used now, conference participants expressed an interest in extending the EMS beyond the district office to school buildings.

This reliance on the Department for information about how to use the EMS (or, indeed, any network) results from the fact that few districts have a trained person who is formally responsible for planning and implementing technological changes in the district. When this is added to the district survey results showing the difficulty most educators have in keeping abreast of developments in educational computing, the importance of feasibility studies such as the current one is increased. It provides some very needed information to people who are very interested in the topics studied, but who are unable to gather the information themselves.

Technical Considerations

In conducting this feasibility study of computer networking, project staff have had to consider issues of both technical and practical feasibility. Practical feasibility involves a consideration of the benefits to be obtained by participation in the network. Whether to use a computer network to allow students to communicate with one another is a practical consideration. Is the value of the communication greater than the cost incurred? Because the value of the information transferred varies from

district to district, it is impossible to generalize about educational networks' practical feasibility.

But some general statements can be made about the technical feasibility of networks. The findings given below are likely to apply to all educational settings in Alaska. This information was used in preparing the suggested strategies for educational networking found in Section 3 of this report. These findings are subject to change as networking technology improves, but they are expected to remain largely correct in the near future.

- Microcomputers have been accepted as effective components of a computer network. (Until recently, only terminals with little or no internal computing power have been used.) Indeed, it is now possible to have a computer network with no computer more powerful than a small microcomputer.

- Because of the acceptance of microcomputers as network components, the hardware and software necessary to network microcomputers is becoming readily available.

- In spite of the advent of more hardware, it still costs between $500 and $1000 to connect a microcomputer to a network. Surprisingly, this amount is about the same regardless of whether the network is local or remote. Further, the cost of adding a microcomputer to a network is remarkably similar to the cost of adding a dedicated terminal to the network.

- This brings up a potential problem in using microcomputers in networking systems. Previous research has found users to be reluctant to spend more than 15 percent of the cost of the computer equipment to connect a station to a network. Thus, spending $2000 for a terminal to connect to a $15,000 minicomputer would be acceptable. Spending $700 to connect a $1500 microcomputer may meet considerable resistance.

- There is also no easy way to handle the physical problems of establishing a network within a school building. The networked computers are almost always joined by cables. These cables are difficult and costly to install in an existing school building. There is little doubt that some otherwise practical networking applications are not feasible because of the problem of running cables throughout a school building.

- The networking equipment is generally reliable. In many networks, however, a single component such as a computer, printer, or mass storage unit is used by all stations. If this component breaks, no one can use the network until it is replaced. Thus, careful design of the network configuration is important, as is a provision for equipment replacement. Regardless, too much dependence on any computer system which does not have a well-designed backup could cause trouble.

- Computers require reliable sources of constant voltage power. If the power to a computer fails while the computer is attempting to read or write to a data file, all of the stored information can be lost. To a school district participating in a network, this might mean the loss of enrollment or financial data that is not easily replaced. Good data processing procedures require that all data be duplicated to prevent such an occurrence, but in some communities uncertain power supplies lessen the feasibility of networking.

- When transferring information among schools, district offices and State agencies, computer networks will have to make use of phone lines and satellite communications. In some locations (not necessarily the most remote sites) the transfer of data across telephone lines is subject to error. These errors can be caused by echos, an overall high noise level, switching noises and a variety of other causes. If these errors are too great, the integrity of the data might be compromised. While an error is relatively unimportant in a memorandum, it could have very serious consequences in financial data. In some communities, therefore, the poor quality of data transfer over telephone lines lessens the feasibility of networking. (There are, however, steps that can be, and have been, taken to improve the quality of data transfer. Echo suppression devices have been added to the earth stations in many communities. Dedicated lines can be made available, at a cost, for data transfer; these eliminate much of the noise present in switched telephone lines. Also, the speed of the data transmission can be reduced; if the transmission is slow enough, most telephone lines will support data transfer. The slower speed, however, increases the cost of sending any given message.)

It is unlikely that any of the technical considerations listed above is sufficient, by itself, to make computer networking completely feasible or unfeasible. But there is no question that technical problems may force networking to provide greater benefits to educators than might otherwise be the case to make it worthwhile to solve the technical problems.

Summary of Study Findings

As described above, the computer networking feasibility study specified by the Legislature was conducted using a variety of data collection techniques. The project staff feels that it was successful in accumulating the data necessary to determine the technical feasibility of computer networking. Some potential technical problems were noted, but computer networking appears technically possible for most of Alaska's local educational agencies.

The results of the investigations of the practical feasibility of educational networking were less clear cut. It will be difficult for local educators to judge the value of specific pieces of information which might be transferred over a network.

Also, there is only a limited amount of software available for the particular applications educators might want to carry out using an educational computer network. Therefore, local educators will have a difficult time determining the value of remote computer networking and are generally unprepared to make empirical cost-benefit decisions about educational networking. The Department of Education could assist educators by disseminating information about networking and acting as a clearinghouse for information about the implementation of networks in those Alaska districts which choose to proceed.

Many of the concerns local educators have about networking would be eliminated if the State were to pay the costs for implementation, much as it did for the existing Electronic Mail System. Participants in the project surveys saw substantial promise in the benefits of enhanced communications available from computer networking. At the same time, however, they have a number of other educational technology priorities which are more important to them than networking. In short, the study shows Alaska's educators to be supportive of the potential of networking, but they do not want to see networking implemented if it means that other educational technology priorities which they see as more important are not addressed.

Section 3
Strategies for Educational Networking

In this section of the report, three alternative strategies for computer networking in the Alaska schools will be discussed. One strategy addresses how to network computers within a school building; another addresses networking between school buildings and their district office; the third addresses the networking of schools and district offices with State agencies and other schools and district offices across the state.

How best to establish a computer network for education would be a suitable topic for an entire book, and it is not a topic that can be addressed completely in this report. In fact, the descriptions of the three networking alternatives have been kept purposely brief so that they can serve as introductory documents for educators contemplating networking implementations. Nonetheless, the information given should be sufficient to describe the most promising techniques for each type of networking.

Alternate Systems of Educational Networking

It would certainly be convenient if a single method for educational computer networking could be identified. If the same equipment and procedures that transferred information from the classroom to the principal's office were optimal for transferring information from the district office to the Department of Education in Juneau, the feasibility of computer networking would be enhanced. Such is not the case, however.

There are three major dichotomies one finds in the design and implementation of computer networks:

- o Networks which share only equipment versus those that share equipment and information
- o Networks where the stations can be connected by cables versus those where they cannot

- Networks used to transfer messages among stations versus systems used to manipulate data

These three dichotomies make considerations of educational networking more broad than might first be anticipated.

This report has already mentioned the confusion brought about by the fact that both local and remote transfer of information qualifies as networking. Further confusion results from use of the term "local networking" for sharing both information and computer equipment. Thus, two computers attached by cables to the same mass storage unit are referred to as a network, as are fifty computers in an office sharing a customer data base, as are two computers sending a message across the country.

The key difference in the networking alternatives is the separation between stations of the network, a difference which is reflected in the terms "local" and "remote" networking. When two stations are located in adjacent rooms, they can be connected by cables and hence are considered to be part of a local network. ("Hard wired" is the term usually used for equipment cabled together.) Indeed, it would be odd to use a telephone line to call the next room down the hall. Stations in a single building or cluster of buildings are almost always part of a local network.

Two school district offices cannot be hard wired, nor can the Department of Education be hard wired to any of the schools or district offices in the state simply because the distances that separate them are too great. Remote communications must be used, and the existing telephone system is by far the most common carrier of data in remote networks. The actual distance between stations is not very important once the limits of hard wiring have been passed. Use of a data base in Los Angeles is no more difficult for a Juneau user than for a San Francisco user.

Although why different strategies are needed for local and remote systems, why should the remote procedures used for school/district office communications be different from those for general data transfer? The difference is the greater degree of specialization found in data transfer between school and district office. There are large quantities of specialized types of data (e.g., financial data, enrollment information) that need to be transferred between school and district office. Once the transfer is made, the school and district office staff have to have specialized programs ready to print, store and manipulate the information. This is different from

using a remote network to access a data base or send an electronic mail message. In these situations, no specialized programming is needed; the information is used as received and is usually discarded after use.

Note that the communications between district offices and the Department of Education could be of either the data manipulation or the message variety. Currently, the Department's Electronic Mail System operates as a message transfer system; the information transferred is not manipulated further by the receiver. But the Department of Education's Division of Management, Law and Finance is studying the establishment of a network among school district offices and the Department that allows remote transfer and manipulation of complex data for enrollment, financial and statistical records. There is some precedent for such a system; the Ohio Department of Education uses a conceptually similar (albeit significantly more sophisticated) system regularly.

Networking within a School Building

Networking of computers is most clearly advantageous when the network exists within an individual school building. This is because the cost effectiveness of the network can be determined without assigning a value to each individual piece of information to be transferred. But in most remote situations, there is a charge for using the network in the form of telephone toll charges and/or charges for connection to the data base being used. In a local system, the cost of the original implementation is (except for limited maintenance) the full cost of the network.

It is certainly possible to transfer information from one local station to another using the local network. In elaborate office automation situations, this may be the primary purpose. The ability of the company president and the secretary to work

on the same document simultaneously is deemed important in many situations. Also, many businesses use their computer to collect information from a variety of sources within the organization; the computer then integrates the results using specialized applications programming.

The circumstances are different in Alaska school buildings. First, the project surveys verified what was already common knowledge—that most schools have only one type of microcomputer, an Apple II. Second, most of the computers in Alaska schools are used to provide instruction. This means there is little modification of computer information; the program information contained on the floppy disk when the school year begins usually remains the same throughout the school year, though student records may be maintained and updated on disks. Finally, very little information is collected from the stations of an in-school network. Although one often hears mention of computerized attendance or grading packages, these have not generally been adapted for optimum networking use, nor have they been particularly successful in single user applications.

Therefore, the most appropriate goal of an in-school network is to make the use of computer equipment more economical or efficient. This can be done by constructing a network which allows sharing of certain computer devices, as discussed below.

(As an aside, there are integrated instructional networks—notably PLATO, TICCIT and Regency Systems—which were investigated during the course of the project. The philosophies of these systems are, however, generally incompatible with the goals and techniques of computer use in Alaska's schools and they don't appear to warrant much consideration.)

Hardware and Software Considerations

There are five ways that an in-school computer network can improve the economy or efficiency of computer use. A network can:

o Allow users to share the same mass storage unit,

o Allow users to share the same printer,

o Allow users to share software,

o Allow data to be transferred among stations, and

o Allow monitoring of activities on multiple work stations.

Each of these advantages requires a particular hardware configuration; these are discussed below.

a. Sharing mass storage

The computer chip that does the processing of instructions in a computer such as an Apple II costs less than $10. While the keyboard, memory, case and other components drive the cost of the computer up substantially, the computer's cost usually seems reasonable. Such is not always the case for the units required to store and retrieve program information.

Small computers usually use a device called a floppy disk drive to access program information and data records. An Apple disk drive which stores about 60 pages of information costs over $500. And even though most student stations do not have that much information to store, every computer needs one or more of these disk drives to bring the information from the floppy disk into the memory of the computer.

About three years ago, hardware manufactures such as Corvus, Radio Shack and Nestar developed methods to permit a large number of computers (as many as 64) to receive information from a single floppy disk drive. Software was developed which polled each of the stations to see if any of them wanted to read from or write to the floppy disk. If two or more stations wanted access to the disk at the same time, the software placed the requests in order and filled them as soon as possible. The systems (particularly those from Corvus) also incorporated larger capacity disk drives; for less than ten times the cost of the floppy drive, users could receive fifty times the storage capacity.

Special hardware is necessary to attach the microcomputers to such a network. In general, a long cable (containing what are called "twisted pair" wires) is run from the computer which will serve as the master unit to the station farthest away. Each station placed on the network requires a circuit board which, in the case of

Apple IIs, is placed into one of the expansion slots in the computer. A device called a "tap" is connected between the main cable and the circuit board. Obviously, some thought is needed to keep the network from becoming a rat's nest of cables, but the establishment of this type of network is not difficult.

The network described above is by far the most common implemented in educational settings. Other more sophisticated networks (e.g., Ethernet, Wangnet) could be used, but they are rarely practical. A system such as Ethernet can transfer data at rates that far exceed the receiving ability of a computer such as an Apple II. The commonly used analogy is that of watering a garden with a fire hose. Since the more sophisticated systems are much more expensive, they are rarely used for in-school networking. The vast majority of the networks are slow-speed systems using twisted pair cables.

The sharing of mass storage is the most common reason for in-school networking. In describing the four other potential applications of networking, the basic hardware will change little.

b. Sharing printers

In common with disk drives, printers are quite expensive and it is usually not possible for a school to have a printer available for each computer. Therefore, the ability to share a printer offers educators significant cost savings. Fortunately, virtually all networks that allow sharing of a disk drive unit permit sharing of a printer in much the same way. The software that controls the system takes requests from the network stations which want to use the printer. Additional requests are simply deferred until the printer is available. The hardware used to connect the network is the same as used for the disk-sharing network.

It is not necessary, however, to have a computer network to share a printer. If the network will be installed to obtain other cost savings, the ability to share a printer is free. But if sharing a printer is the sole goal, there are switches which can transfer control of the printer to whichever computer requires it at the time. This technique is less sophisticated, but is less costly and much less complicated.

c. Sharing software

One of the rationales educators frequently use to support networks is the ability to share software. Rather than dealing with a large number floppy disks containing individual programs, school personnel could place all of the programs on a large capacity disk drive. Students could then access any of the programs without any physical access to the disk. Since the disks are handled less, there will be less trouble with program errors. Also, several students could use the same program at the same time, even though the school had purchased only one copy.

There are two difficulties with this approach. The first is that the sharing of software in this manner is almost always unlawful. Most of the licenses for educational software restrict use of a software package to the computer for which it was purchased. Although most educational publishers will make special arrangements for schools which wish to share programs across computers, this is not the common arrangement and the legality of the sharing should not be taken for granted.

The second difficulty is even more severe and has caused considerable difficulty among unwary educators. Much of the education software used by Alaska educators is protected from unauthorized copying by one or more protection schemes. Many of these protection schemes are not compatible with the software which controls the networking system. Thus—the legality of the sharing notwithstanding—certain programs simply will not run correctly under a networking system. While the educational publishers could modify their software to avoid these problems, it is not in their economic interest to do so and thus it is not being done on a widespread basis. In short, implementation of a networking system based on the advantages of software sharing is rarely justified.

d. Sharing data across stations

As mentioned above, one of the principal advantages of computer networking in business is the ability to transfer data among stations. The same benefit might be a reason to implement an in-school educational network. But there are certain circumstances about education in general and Alaska education in particular that limit the advantages of shared data.

First, there is little educational programming that is constructed to take advantage of this type of information transfer. The vast majority of educational administration and instructional programs are configured for single users. Second, the fact that Alaska schools overwhelmingly have the same brand of microcomputers makes some of the advantages of a network moot. It is, for example, almost as easy to physically carry a floppy disk containing information to be shared to an adjacent workstation as it is to transfer the information electronically. Compatibility among the various stations is rarely a problem.

Also, the physical size of many Alaska schools makes the value of networking less important. While electronic data transfer might be valuable for keeping attendance information at a large Anchorage high school, its value would be almost nonexistent in most of Alaska's rural schools. In general, the sharing of data across network stations will be of limited advantage to Alaska schools.

e. Monitoring activities at various stations

Some of the educational networks allow the system to be configured with one of the computers as a master station. This master station can communicate with other stations and can examine their activity. There are a few systems which can be set up to allow messages from the master station to appear on the screen of any or all of the other stations.

Obviously, such a system might be of significant benefit to educators who could monitor the activities of their students and who could provide help simply by typing on the master station. There are some characteristics of computer-based education in Alaska which make such a system less advantageous than it might seem. First, little educational software is set up to facilitate brief observation by the teacher. Few programs keep detailed records of a student's progress through a lesson. Some don't even have a readily apparent indicator of where the student is in the program at any given time. And virtually none of the programs aggregate information about the mistakes a student might have made so that a teacher could quickly provide guidance to the student.

But an even more important factor is the way computer-assisted instruction is carried out. The advantages of observing student progress would be significant if a large number of students were simultaneously working on a given program. The teacher could then deal with only one block of content and could note the relative performance of students. However, while a few "computer laboratories" are used this way, most Alaska educators (a) do not have a computer available for every student and (b) do not have all of their students working on the same program at the same time. The disparity is particularly great in the many multigrade classrooms in Alaska. Indeed, except in a very limited number of cases, the ability of a computer network to permit teachers to observe student performance is not a practical advantage.

Costs

Since the in-school network does not incur telephone charges for transmitting data, determining the cost of a network is relatively straightforward. Two sets of cost information are required—one for the cost of a networked system, one for the cost of the equivalent non-networked equipment. Since the advantages of networking to Alaska educators are limited, beyond the cost savings, a comparison of these two total costs will indicate whether the networked system should be implemented.

The cost of adapting a microcomputer to participate in a network is slightly over $500 for an Apple II. Some computers, such as TRS-80 Model IIIs, which already have appropriate communications ports on the back of the machine, can be adapted for less. Others, such as the IBM Personal Computer, cost slightly more, in part because vendors have not had as much experience producing the networking circuits for those machines. But the $500 figure is a good general estimate.

There are also costs for the taps (about $50) needed to connect to the main cable and the cost of the cabling itself (this varies considerable, but $ .50/foot is a reasonable estimate). Most companies charge separately for the software needed to control the system. This cost must be added in, as must any charges for installing the cable in the building. This latter cost can be extremely high for some installations.

The cost of disk drives varies depending on the capacity of the disk. A small capacity drive costs about $10 per page of text that could be stored, whereas a large capacity drive would cost about $1 per page. An Apple II floppy disk drive costs about $500. A rigid (hard) disk drive capable of storing 5 megabytes (over 2500 pages of text) costs less than $5000. Note that our equation is getting somewhat complicated. Assuming the computer is already purchased, you could spend about the same amount of money for its own floppy disk drive or for its adaptation to fit into a network. Cost would not be the deciding factor on which route to take. But at some point the increased storage of the larger disk might be advantageous. Remember too that the network facilitates sharing of printers, which might also make the networked system advantageous.

The most important concept concerning the cost of in-school networked systems is that the costs can be known and evaluated in advance. No guesswork is necessary to know whether the networked system is preferable. The Department of Education may be able to play an important role by assisting school districts in making decisions about the cost effectiveness of networking.

Suggested Strategy

When the feasibility study project started, the plan was to provide specific information about alternatives for networking in Alaska education. Early in the project, the differences between the three types of networking (in-school, schools to district office, schools and districts statewide) became clear and the focus was changed to specifying preferable strategies for each type. But as discussed above, the strategy for in-school networking is not particularly complicated. But there are limited advantages that accrue to educators who use in-school networks.

For the majority of Alaska's schools, the preferred strategy for in-school networking may be not to do it. This advice would be different were there more educational applications that were configured to take advantage of the information transfer possible through a network. But in-school networking systems, while entirely feasible from a technical point of view, are currently to be recommended only when the configuration leads to a cost savings. And as stressed above, it is entirely possible to determine whether such savings will result.

If the calculations show that cost savings would result, implementors have a number of choices for networking equipment. Brief specifications for some of the more popular networking equipment have been included in the Appendix. In selecting networking equipment, particular attention should be given to the amount of support available from the equipment vendor and manufacturer. While the in-school networking systems are not particularly complicated, it is possible that a number of questions will arise during installation of the equipment. Attention should also be given to the issue of redundant equipment; care should be taken that no failure of the networking equipment will cause unacceptable downtime.

One of the important strategies developed from the feasibility study is that information about the implementation of networks in Alaska schools should be passed on to other educators in Alaska. The Department of Education could help fulfill this role, as could the Alaska Association for Computers in Education. By sharing the information learned in the first networking implementations, future networks can be implemented more effectively.

Before leaving the subject of in-school networking, some consideration should be made of changes that might occur in the near future. There has been considerable growth in the capability of low cost computers. During 1983, it is expected that computers with 64 kilobytes of memory, detailed graphics and other important attributes will become available for under $400. Whether they will be useful in education will depend largely on the amount of educational software that is developed. But the effectiveness of these machines will be greatly increased if low-cost methods are developed to connect these computers to networks. Many people suspect this may happen, and such a development would substantially increase the number of justifiable installations of educational networks.

Networking within a School District

Introduction

The survey of district computer coordinators conducted as part of the feasibility study showed the largest quantity of information transfer to take place between a district office and the schools in the district. Also, the communications between schools and the district office are often critical to the day-to-day operation of the district. Indeed, discussions at the networking conference suggested that improved communications between schools and the district office might improve the quality of education within the district. Therefore, one might correctly presume that some of the greatest advantages of educational networking would be obtained by implementing such an "intradistrict" network.

There is considerable precedent for intradistrict educational networks. As long as fifteen years ago, some large districts began to use computers to maintain a variety of student and financial records. A fairly small number of these districts placed communications terminals in the school buildings. These early attempts to establish networks were not always successful; the users were not always well trained, the equipment was not always as reliable as necessary, and, most important, there was an extremely limited amount of applications software that made effective use of the networking capability.

As use of the computer increased, thousands of school districts purchased computer equipment and hired data processing personnel. The combination of more reliable equipment and staff members dedicated to making the computers work effectively brought considerable improvements. In the early 1980s, school districts of all sizes and locations have established computer networks and the number is increasing constantly.

States with small populations spread over a wide area have relatively few intradistrict networks. There are probably fewer intradistrict networks in Alaska, Nevada, North Dakota and South Dakota combined than there are within a fifty mile radius of San Francisco. The reasons are simple. A small student population makes the per capita cost of the network much higher; it costs the same amount to place a terminal in a school of 2000 as a school of 20. Also,

if telephone calls between schools and the district office are toll calls, the cost of the network increases dramatically. Finally, it takes skilled data processing personnel to install, develop and maintain a computer network; small districts have less ability to support such professionals on their staff.

Nevertheless, some Alaska districts would profit from installation of intradistrict networks. Unfortunately, there are no rules of thumb, either from general research or from the survey data, that help specify in which of Alaska's 53 school districts the networks would be cost-effective. Before an Alaska district decides to implement a network, it needs to receive qualified design assistance for the network. But even before taking that step, the district needs to conduct a study to determine the information that would be transferred across the network and to assign a dollar value to the rapid transfer of that information. This step is critical; without it, there is no way to know whether the benefits outweigh the expense and complexity associated with the network.

The best configuration for an intradistrict network depends on many factors, the most critical of which are the number of stations, the frequency of use and the communications available to link the stations. The network one would use in the Anchorage district has little in common with the best network for North Slope. (And, of course, a number of Alaska's districts have only one or two schools; these districts may be able to establish local networks such as described in the paragraphs on in-school networking.) There are, however, some generalities about intradistrict networking; these are discussed below.

Hardware and Software Considerations

The intradistrict network is much more complicated than the local network discussed above. The complexity comes from the remote nature of the communications and, frequently, the need to use larger, more expensive computers to run the network.

The question of what computer to use for intradistrict networking deserves careful consideration. Whereas local educational networking is a recent development that postdates widespread use of the microcomputer, intradistrict networking achieved maturity using mainframes and minicomputers. Also, most data processing people who are responsible for networks have been trained on and are experienced with larger computers. In short, there is not a lot of experience in how well microcomputers might work for intradistrict networking.

But there is ample reason to consider using microcomputers for this type of installation. A minicomputer installation generally costs upwards of $50,000. While the minicomputer offers substantial advantages in processing speed and mass storage, these advantages would not be of much benefit to a network with only a few users. Machines such as Digital Equipment's VAX 11/70 or the Hewlett-Packard 3000 are fine computers, but they are complicated and expensive, and they probably could not be operated by someone other than a well-trained data processing professional.

A microcomputer suitable for intradistrict networking would cost less than $25,000 and could be operated by district staff if they had received extensive training and had access to technical assistance as needed. The variety of potential vendors (over 50) makes it impossible to talk about the specifics of a given machine, but the growth in this area has been dramatic and few districts will have difficulty finding an appropriate computer around which to build the network.

The kinds of microcomputers familiar to Alaska educators are not, however, suitable for intradistrict networking if the computer is to be used

to manipulate substantial amounts of data (as opposed to just transferring messages). An Apple II or a TRS-80 Model III is much too small to handle the full range of networking requirements. While many would claim that networks using such equipment exist, these networks are extremely limited in their functions. Neither the internal memory, the mass storage capacity, nor the number of available ports on such machines is adequate to permit the expandability necessary to an educational network.

Expandability of a network is a very important consideration. If the initial efforts to use the network are successful, then users will want additional applications for the network. If the network has not been planned carefully, the requisite expansion will be impossible (or, at least, too costly) to carry out. The ability to expand the network materially affects the feasibility of the network; there is a delicate balance between system cost and capability which can only be held if it is possible to use a relatively small system for the initial applications and then efficiently expand the system as additional applications become desired.

An intradistrict network in Alaska will almost always use a combination of telephone lines and modems to transmit the data between stations. Here again, care needs to be taken in specifying the equipment to be used. Access to telephone lines is expensive; thus, the number used should be as low as possible. The most grievous error in networking, however, is to have an inadequate capacity so that eager users are forced to wait to access the system. Many of the computers that would be suitable for this type of network have a number of serial ports (often 6, 8 or 16), each of which could be dedicated to a remote station. But at a certain point, the cost of telephone access and modems will make it more economical to use a device called a multiplexer as part of the system; the multiplexer polls all of the stations and passes on the information from those stations requesting service. Stations which are not active use up none of the network's resources.

Even the most carefully chosen set of equipment will do no good if appropriate applications software is not available. It is useful to consider

the advantages of sending attendance data, equipment requisitions, financial information and the like across an intradistrict network, but is there software available to transfer the data efficiently and manipulate it when it is received? Probably not. Further, the cost of developing such software may be prohibitive for many of Alaska's smaller districts which do not have programmers on staff and who have only a few schools across which the costs can be distributed. Indeed, the most cost effective applications will be those developed by the Department of Education itself for statewide use. Although the effort required for programming, debugging, maintaining and updating any network system will result in considerable expense, a significant portion of the costs for statewide applications would be borne by the current data processing staff of the Department's Division of Management, Law and Finance.

Costs

When discussing local networking, much was made of the fact that the cost of the equipment was, except for maintenance, the major expense. In intradistrict networking, the district will incur continuous charges resulting from the cost of the telephone lines necessary to transfer data. (There are other ways to transmit the data, but none are sufficiently practical to warrant consideration in the immediate future.) This reoccurring expense for toll charges means that each use of the network costs money and, therefore, every piece of information transferred must have some worth. It will cost X dollars to transfer a requisition and Y dollars to transfer attendance information, and the value of the instantaneous transfer of machine readable data should be at least equal to the cost. The value of transferring information in machine readable form should not be underestimated. Whether information is transferred from schools to districts or from districts to the Department of Education, the reduction in the time for the data exchange and for entering and correcting data for submission to the processing computer results in considerable savings.

Remember too that the important consideration is not absolute value of the data, but the value of rapid transfer of the data. Most data are transferred successfully by mail or voice communications already. In fact, most educators don't know what change there would be in the types of data transferred, only that the network would increase the speed at which the transfer takes place. This caveat is important, for there are instances of networks which

were installed but never came close to cost effectiveness because the information simply was not of sufficient importance to justify the expense of transferring it rapidly.

It is impossible to specify the precise costs of an intradistrict network, but some rough estimates can be given. The computer to operate the network will probably cost over $10,000 but would not, for the majority of districts, cost more than $25,000. Each station participating in the network will need a terminal and modem costing together roughly $2000. Suitable printers would cost between $700 and $3000 each. Additional supplies and cabling would add several hundred dollars per installation. The cost of the software will depend on its complexity and the availability of packages that provide starting points for customization. (Incidentally, one advantage of microcomputers over larger computers for educational networking is that their software packages are less costly, easier to understand and modify, and often easier to transport from one computer to another.)

From the above information, one can determine an approximate cost for an intradistrict network. But as stressed above, estimates also have to be made of the ongoing cost of transferring data. The useful life of the equipment should be estimated (five years is a reasonable figure) so that a yearly cost can be determined. Adding the equipment cost to the ongoing cost gives a yearly cost which can be compared against the value of the information transfer. While these estimates do not allow for the precise, objective decision making possible for in-school networking, the decisions can still be substantially objective and carefully derived.

Suggested Strategy

One way to reduce the cost of both hardware and software is for the districts of Alaska to adopt common equipment and procedures. If, for example, all of the districts in Alaska were to agree on a common set of computer equipment, the volume purchasing which would be possible would lower costs. It would be much easier to train users on a single set of equipment. Also, maintenance could be much improved because it would be possible to stock

a wider variety of replacement parts in Alaska if there were many similar computers. The same advantages hold true for all other equipment, such as modems, multiplexers, terminals and printers.

Even greater advantages would accrue from a subsequent agreement to use the same computer software. The very high cost of programming the educational applications needed would be more tolerable were it spread across the majority of Alaska's districts. If only one attendance program needs to be prepared for one type of computer, that programming task becomes much more feasible than if thirty different programs need to be prepared. Training people how to use the programs becomes many times easier, too. All things considered, there is much to recommend standardization of hardware and software for intradistrict networking in Alaska.

Education agencies have, however, been loathe to adopt standardized operating procedures. The situation becomes even worse in states where the districts are (or even view themselves as) relatively diverse. The district in northeast Washington may decline to use the same accounting package as the Seattle district simply because its administrators refuse to believe that the districts could have any procedures in common. The reality of the situation is often beside the point; there are cases of principals in two high schools three miles apart refusing to accept the same accounting package because their procedures were irreversibly different. Further, there is almost no predeveloped educational software for administrative purposes simply because software developers do not feel there is a sufficiently uniform market to justify the development costs.

Alaska districts may be somewhat more amenable to standardization than districts in other states. They have had the experience of the statewide Electronic Mail System to establish the precedent for equipment standardization (although this may have no relevance when districts are responsible for purchasing their own equipment). Also, the feasibility survey of district computer coordinators found that a number of districts already use the same external computing service for some of their business

computing needs. Besides this, there is little evidence that the statewide standardization of equipment and procedures would be acceptable.

The implementation of individual intradistrict networks is, of course, a task for district staff and such consultants as they might hire. The data collected during the feasibility study showed, however, that many districts would appreciate receiving guidance from the Department of Education about how to implement and use technologies such as networking. Whether the Department of Education can fulfill this role seems to depend largely on the priority of this assistance versus the other responsibilities the Department has toward educational technology.

The implementation of a standardized network can be handled only through the direct involvement of a state agency such as the Department of Education. There is virtually no evidence of successful establishment of a standardized network through de facto procedures; even the Ohio Department of Education's relatively successful statewide network has had to allow for a number of incompatible computer systems.

In fact, Alaska's quasi-standardization on the Apple II as its instructional microcomputer is about the best example of a success story. The surveys conducted as part of the feasibility study showed that most of Alaska's school districts have Apple II microcomputers; they also showed that few districts used other microcomputers for instruction. Nevertheless, a completely standardized network would be more complicated, and is unlikely to develop without specific efforts to make such standardization occur.

The extent of immediate and long-term Department involvement in intradistrict networking could not be determined from the feasibility study. While educators think improved communications would be very helpful (most of those surveyed thought that it would actually improve educational quality), there was no evidence that the careful analysis that needs to be done at the school district level before committing resources to networking projects has

started. There seems to be much to recommend the Department providing advice and technical assistance to districts contemplating intradistrict networking, but additional study needs to be done before becoming involved in any large scale project.

Networking across the State

Introduction

The impetus for the feasibility study of educational computer networking actually came not from a desire to implement sophisticated in-school or intradistrict networking systems, but from a simple desire to allow students and teachers in Alaska's schools to communicate more efficiently with one another. Alaska's students and teachers have experiences and knowledge to share with one another, and the possibility of using the microcomputer to permit such sharing is worthy of careful consideration.

Early in the feasibility study, discussions were held to determine the practicality of establishing a true statewide network, that is, a network which would provide students and educators in virtually every community in Alaska with the ability to communicate electronically with one another. Technically, such a network is feasible to the extent that communications links (principally telephone service) are available to the communities. Indeed, there is considerable precedent for such activities; the state's efforts to bring television reception to Alaska communities is similar to the type of effort that would be required for a true statewide network. (The term "true network" is used, for want of a better term, to identify a network established for the purpose of communicating within the state of Alaska. It differs from the remote nationwide networks that Alaskans can access in its greater attention to statewide needs and the configuration of its equipment and software to best meet statewide needs.)

Implementing such a network is both costly and complicated, however. For this reason, a strategy for implementing a much less elaborate network system is proposed below. This strategy is presented without comment on the potential of the full true networking system. The feasibility study did not produce enough data directed specifically to the question of the merit of true statewide networking to comment on its precise value. Some additional comments on this issue are contained in the strategies section below, however.

Hardware and Software Considerations

The capital cost for installing a true statewide network would easily exceed a million dollars and would probably be several million dollars. This does not mean, however, that Alaska educators cannot participate in statewide data transfer before such a networking system is put in place. There is, in fact, much to recommend the careful, but immediate, investigation of the potential benefits of networking for Alaska's districts.

As stressed several times in this report, networking is inherently tied to telephone service. The standard telephone service is not the best alternative for data transfer, but it is the communications link which is most widely available. Various companies have taken advantage of the access to networks provided by the existing telephone service by offering networking services to any individual or organization which can access their computer through the telephone system. Once connected to their computer, the service provides subscribers with access to various data bases, the ability to run programs using the service's computer, the ability to send electronic mail messages to other subscribers, and a variety of other services.

These services have several major drawbacks which work against their use by Alaska educators. They are expensive to use. The "products" they offer are limited and not particularly tailored to educators. Likewise, their services are not tailored to Alaska students, educators and community members. It would be difficult to get changes made in the services to better suit Alaska users. These are nationwide services and such services cannot be expected to provide as high a level of service as a specially developed Alaska education network.

To offset these drawbacks, the services offer two tremendous advantages. First, they can be used by the Alaska Department of Education or Alaska's school districts with very little investment. Given that a true statewide network is a multimillion dollar proposition, this is an important virtue. These services can satisfy only a portion of the potential applications of Alaska educators, but the cost of implementing those applications is comparatively very low. Second, the services are available now, whereas a true network would take upwards of two years to implement.

In discussing the feasibility of both in-school and intradistrict networking, mention was made of the unfortunate lack of educational software that takes advantage of the benefits of networking. The services would not be able to provide specialized educational programming designed for Alaska's schools. But since little such software exists, the point is much less important. This does not mean that certain kinds of software might not almost "singlehandedly" provide the rationale for a true network. For example, the Department of Education might find it beneficial to use a network for a cooperative financial management system with school districts; the value of good financial management might be sufficient to warrant implementation of a network. The same may be true of the statistical information or student accountability information the Department needs. But only if the State or individual districts embark on major software development efforts will the advantages of true networks become more clear cut. For the moment, however, the fact that the services cannot provide state educators with their own tailored software is not a unique shortcoming.

The equipment necessary to access one of the major telecommunications services is quite modest. Only a modem and a terminal with no intelligence are needed. Most installations, however, will want to connect a printer to the terminal so that hard copies of messages and data will be available. A microcomputer could be used in place of a terminal if that were advantageous.

The question arises whether to use a microcomputer or a "dumb" terminal to access the network. Most Alaska schools and district offices have access to an Apple II computer. This computer can function as a terminal on a network. But there are difficulties with this approach. A considerable amount of easy-to-use software is available for the Apples to allow transfer of simple messages. But as the complexity of the data to be transferred increases, the suitability of the existing communications software declines. Also, several experts point out that any terminal for serious use needs to present the text in 80-column rows (a standard Apple displays 40 columns); a special circuit board is necessary to provide the denser display. The computer will also require a modem. But additional problems arise in that some display boards have been found to be incompatible with some common modems. In short, use of an Apple II as a networking terminal is certainly feasible, but it is not as straightforward as one might first expect.

There are a few terminals made specifically for the purpose of accessing telecommunications services. One, for example, is manufactured for the TymShare telecommunications company. This terminal, called a Scanset, serves as a good example of the dedicated information access terminal. The Scanset and its equivalents have built-in modems and usually have automatic dialing units that can store and dial the lengthy telephone numbers necessary to access the services. Some can also store account number and password information. These terminals are designed for non-computer personnel and are quite easy to use. No specialized training is necessary.

When educators access a telecommunications service, they are involved with two types of access. First, the user must access a provider of data base services. This company is a common carrier which has been licensed to provide such services. In Alaska, TymShare (through its TymNet system) and Alascom can be used to access information services. Neither of these common carriers directly provides services, although Tymshare operates the OnTyme electronic mail system. The activities of these common carriers are of considerable statewide importance, for the access they provide and the rates they charge directly affect the feasibility of statewide educational networks. (For example, Alascom has recently proposed a long range plan for a statewide network called AlaskaNet. The coverage and costs of this system will directly affect future networking plans; it is therefore appropriate for the Department of Education to work along with the Department of Administration in considering the impact of the system.)

Once the common carrier has been accessed, the user then must access the information supplier itself. Some of these suppliers offer a wide range of information. Companies such as Source Telecomputing and Compuserve offer airline schedules, games, restaurant reviews, product buying services and so on. Of more relevance to educators, they offer electronic mail services and a number of research and archival data bases that would be useful for student and educator research projects. Other data bases are much more specialized. Educators can access the ERIC research collection, the School Practices Information Network, a newsletter service run by the staff of Education Today and so on.

Many of the information services also have methods of storing and transferring data files and a few allow access to their own minicomputers for running programs. The practicality of such uses is questionable because of the charge for being connected to the network, but the examples are presented to show that there are few applications which could not be conducted, albeit inefficiently, through such networks.

The electronic mail aspects of the information services are more practical. These electronic mail systems do not work any better than the Department's Electronic Mail System. But the Alaska EMS is not easily extended to the hundreds of Alaska schools; currently only school district offices make us of the system. Both the cost of the equipment necessary for such an expansion and difficulties in communications with some rural communities keep the expansion from being an obviously beneficial approach. The cost would be substantially over a million dollars, and project surveys indicate school sites have a higher percentage of telephone problems such as echos and line noise than communities with district offices. Other advantages of an EMS expansion may make it a feasibile project, but additional study is necessary to determine its desirability. But by using a nationwide EMS, any school with a terminal or microcomputer, a modem and access to a telephone can send and receive electronic mail. Since the impetus for the networking feasibility study came from a desire for students and educators to communicate easily with one another, this is a valuable characteristic of the information services.

Costs

As stressed in the earlier paragraphs of this section, one of the advantages of the approach suggested by the feasibility study is the low initial cost. One of the Scanset terminals described above can be purchased for $700. No additional equipment is necessary, although many sites will want to add a dot-matrix printer to produce hard copy; such printers cost about $600.

This low cost is important because it will be difficult for school districts to determine in advance the actual benefits they might receive from

the network. This modest approach puts relatively little at risk, particularly compared to the costs incurred with true intradistrict or statewide networks, which cost many, many times more. To the extent that the two approaches can provide the same benefits, the lower cost method should obviously be used first.

The absolute cost of the specialized terminals is lower than the cost of using a microcomputer such as an Apple II. An Apple II is a $1500 microcomputer, and it needs a $200 modem, a $350 80-column display board, about $100 of software and possibly a printer interface card. Even if the computer itself is assumed to have no cost (because it is already available), the cost of modifying the computer could be as high as $600. The technical review conducted during the feasibility study suggested that the nearly equivalent cost would make the specialized terminal preferable because it would not prevent the microcomputer from being used for more important tasks such as instructional delivery. Also, a terminal such as a Scanset would be easier to use and would allow a degree of standardization that would be difficult given the variety of modems, display boards and communications software Alaska schools can choose from for their Apple IIs.

But during the networking conference, several local educators expressed a preference for using their Apple IIs for any network access they undertake. Some expressed doubt that the cost of a separate terminal could be justified, while others were reluctant to learn to use a new type of equipment. They also stressed a point with which project staff were familiar—when using a microcomputer, messages can be prepared using the computer and then transferred quickly across the network, instead of requiring connect time for the actual preparation and typing of the message. (Whether this is an important factor would depend entirely on the use to which the network is put by users; message forwarding would profit considerably, data base searches little.) This discrepancy between the technically most effective method—using special purpose terminals—and the method preferred by the potential users—adapting their Apple IIs—remained unresolved as this report was prepared. A brief survey for the sole purpose of resolving this issue may be in order.

Time and time again, this report has stressed the importance of weighing the cost of access to information through a remote network against the value of the information transferred. Alaska districts can expect to spend about $25 per hour

of connect time to a network, roughly $ .50 a minute. If a teacher wants to send a short message to another teacher, it will take a few minutes and cost the district perhaps three to five dollars. There is then a charge for accessing the information source itself, perhaps another $ .25-$ .50 a minute. If a student wants to research the New York Times archives for preparing a term paper, half an hour of connect time would cost the district twenty or thirty dollars.

This is not meant to imply that Alaskan educators would be surprised at these charges. The cost of using the Electronic Mail System is of the same order of magnitude. It will be the responsibility of the individual district or school to determine whether any given use of the network is worthwhile. The data collected during the study showed that some of the districts have reduced use of the EMS because they do not find the information worth the cost, while other districts find the EMS a valuable service well worth the cost. Since Alaska educators don't yet know the benefits available from the information services, some experimentation is in order. The Department may want to assist in establishing some pilot schools to use the information services and evaluate their benefits. The information gathered from the pilot sites could then be passed on to other districts to assist their decisions about network use, and could be used by the Department to determine whether more elaborate networking systems might be useful.

Suggested Strategy

The general strategy for statewide network use that emerged from the feasibility study has already been described in the course of discussing the hardware, software and projected costs. There are three critical points:

- o The value of the information available from a statewide network is not yet known. Therefore, a period of experimentation is in order.
- o The costs of participating in the network should be kept as low as possible until the value of the network can be determined. Specifically, there is not yet sufficient evidence of the benefits of an expensive true statewide network, even though such benefits may be extensive.
- o A true statewide network could not be designed, implemented and tested in less than two years. There is reason, however, for the Department and Alaska districts to begin using networking services as soon as possible.

These three criteria suggest use of existing networking services and the dissemination of information about the benefits that can be derived.

There should be no confusion about the study's findings about the potential of the true statewide system that the Department of Education could implement. Such a network would be a major undertaking and would cost a large amount of money. None of the data collected in the study showed that this would be a good use of Department resources; indeed, the data showed that educators had several other educational technology problems they considered more important. But the study also indicates that educators do not really know about the benefits that could be derived from a statewide network; it is, therefore, scarcely surprising that they do not consider it a priority. Investigations by the Department of Education suggest there are beneficial and, indeed, necessary applications for a statewide computing network. The Department needs to make a decision whether to continue these investigations in order to determine the precise benefits that might accrue from the network and the effort required to put it in place.

The Legislature raised two other important issues about the computer and its role in communications. It directed the Department to consider questions of the compatibility of computers across Alaska. Also, in directing the Department to conduct a study of computer literacy, it suggested that some attention be given to the use of computers by community members other than students. The question of how to network computers across the state, and the benefits of such networking is somewhat dependent on these two issues.

Computers can be compatible at several levels. The highest level of compatibility is that a program contained on a floppy disk from one computer can be inserted into the second computer, at which time it will run perfectly. The screen graphics must be the same, the keys used to control the program must be identical, and the information in the program manual must apply for both computers. With only a couple of exceptions, this level of compatibility is achieved only when the computers are identical models.

This lack of compatibility is less of a problem for Alaska education because of the de facto standardization of the Apple II microcomputer for instructional applications. It is likely that as the Apple becomes less modern—it is five years old already—districts will purchase other microcomputers and some of the standardization will be lost. Still, schools in Alaska are generally able to transfer information by floppy disk among their Apple II computers.

One of the exceptions mentioned above is that some computers (including the newer versions of the GNAT microcomputer used for the Electronic Mail System, but not including the most popular instructional microcomputers such as the Apple II) use a common operating system which permits programs to run on all computers which use that operating system. The computers must also have the same size disk drives if the programs are transferred on a floppy disk. If all of the programming needed for statewide educational use were prepared under this operating system, the programming would run on approximately 75 different models of computer. (Unfortunately, these 75 different models make up less than 20 percent of all the installed microcomputers because of the dominance of a few computers—such as the Apple II, Radio Shack Model III, and IBM Personal Computer—which have incompatible operating systems.)

The second exception which impacts compatibility is the ability to transfer data files without compatible computers. There is, for example, little in common between an IBM mainframe and an Apple II. But data transfer programs have been developed which permit the data from an Apple II to be sent to mainframe computers. It is important to note that in no way are the computers compatible to the point of running each other's programs. But it is possible to generate a list of student names on an Apple II and have it arrive intact at the mainframe. This transferring of characters back and forth is relatively straightforward and encounters few compatibility problems. But whether the receiving computer can use, or even display, the data it received is a rather complicated software problem. In general, it would be best to view data transfer between incompatible computers as possible but of limited benefit.

The question of how the citizens of Alaska communities could make use of a computer network is not particularly complicated. The procedures discussed above for statewide networking are not dependent in any way on the educational environment. Using the computer network simply requires access to the equipment and a small amount of training in the appropriate procedures. If the computer terminal is placed in a community's general store instead of its school building, community members can use the network just as well as teachers and students.

Surprisingly, however (given the ease with which it can be done), very few educational agencies in the United States have taken responsibility for bringing networking to the adults in a community. Many organizations will teach community members about computers through programming or computer literacy courses, but relatively few have provided any access to computers outside of the instructional environment. Since one can safely assume that non-educator adults have as much need for electronic communications as their children, it is unfortunate that more attention has not been given to making computer networks accessible to the general community. The technical reviews conducted during this study suggest that this approach is entirely feasibile.

Section 4
Conclusion and Recommendations for Future Activities

Conclusions based on the data which have been collected and recommendations derived from those conclusions are included in this section. The section ends with some closing comments summarizing the feasibility study.

Conclusions

Technical information gathered as part of this feasibility study suggests that the hardware and software necessary to implement computer networking in Alaska education are, for the most part, currently available. Further, even greater improvements in the practicality of such equipment for use in individual schools may occur within the next 18 months. Also, surveys and discussions conducted with a representative sample of Alaska educators suggest that they believe the quality of education in their localities could be enhanced by improved communications such as might result from computer networking efforts.

Two findings limit this enthusiasm, however. The study found many educators reluctant to expend limited local resources for electronic communications simply to enhance the timeliness of the information being sent. Educators left the impression that networking systems, be they local or statewide, should be shown to be cost effective before they are implemented. Second, the educators, while advocating computer networking and expressing interest in its implementation, ranked networking activities as less critical than several other educational computer areas (for example, acquisition of instructional and administrative hardware and software). The conclusion is that the Department of Education should conduct activities to investigate and support implementation of educational networks, but such activities should not preclude providing support in other areas of educational technology.

Recommendations

The information collected from the feasibility study suggests several recommendations about the future direction of computer networking in Alaska education, as follows:

1. The Department of Education should continue to keep abreast of new developments in computer networking. They should share this information with staff in local school districts, along with more information about the potential benefits of educational networking. They should keep the Legislature informed about any technological innovations which might affect the feasibility of computer networking among Alaska's educational community.

2. Department resources should be used to work with a few pilot school districts which are interested in establishing different levels of computer networks (in-school, school to district office, schools/districts statewide). Resources should not be provided for the Department to purchase necessary hardware for the pilot districts; that should remain a district responsibility. But resources for providing technical information, staff training, and thorough evaluation of the value of the networks should be provided to the Department. As in recommendation #1, results of the pilot investigations should be widely disseminated to Alaska educators.

3. Since it is the districts which must decide to purchase necessary hardware, presumably the decision will be made based on an assessment of the benefits to the district of having a computer network system. When districts decide to participate in the recommended pilot test or otherwise acquire networking capabilities, the Department should gather information on the processes used by the districts to determine expected benefits of the network system. These expected benefits can serve as one basis for evaluation of the success of any pilot effort, and the processes themselves can be refined. The information can then be made available as other districts contemplate adoption of networks.

4. The Department should provide districts with a full description of the capabilities (including any new ones that have been developed since implementation) of the existing Electronic Mail System. Additional training should be provided if necessary.

5. Department staff should continue to work with appropriate persons in the Department of Administration as the new statewide data communication system is planned. Long-range planning should be undertaken by Department of Education staff to determine desirable configurations and potential uses of a statewide educational computer network that will become possible with the advent of the larger statewide system.

6. Resources necessary to undertake the activities of recommendations #1-5 should be carefully allocated so that they do not handicap responsibilities the Department has for working with schools in other educational technology areas.

These recommendations are supported by the results and conclusions gathered during the study. In summary, they encourage constant attention to the feasibility of computer networking in Alaska education and a modest pilot effort aimed at determining the value of the networking process, but suggest that commitments to networking technology be made carefully so that other—perhaps even more important—educational computing needs can still be addressed.

Closing Comments

This report has summarized the results of a four-month study commissioned by the Alaska Legislature and conducted by the Department of Education. The purpose of the study was to determine the feasibility, benefits and costs of a system of computer networks that would enable schools to use computer communications for the purposes of instruction and administration. The study also was to include attention to the means by which computers used in education may be made compatible statewide. Through a series of activities, data were gathered from Alaska educators, staff from other State agencies, and the technical literature to allow those questions to be answered.

Networking—as with most computer-related technologies—is in a state of rapid growth. This report has attempted to provide a discussion of the feasibility of networking as it applies to educational settings. But it is a field that is constantly changing, and a field with which educators are not always familiar. The benefits of networking can be substantial, but careful planning and implementation are needed if those benefits are to be realized. This study found educational networking to be feasible in many different forms and settings. But the study findings also suggest that care and caution be foremost in Alaska's educational networking efforts.

Section 5
Appendix

The feasibility study on computer networking in Alaska education gathered a great deal of information which cannot be included in the body of the project Technical Report because of length. Some of that information is included in this Appendix. Included in the following pages are copies of the survey instruments used during the study, with results provided. Also included are the materials (invitations, participant lists, discussion guides, etc.) associated with the networking conference.

An Overview of the Appendix

Besides the survey data, the study collected a great deal of technical literature about the components of and procedures for an educational network. It was thought useful to include a small amount of this information to serve as examples for readers. Therefore, included in the appendix are copies of technical information and specifications for the following:

- o Equipment for in-school networking
- o Terminals for accessing remote networks
- o Software for telecommunications activities using microcomputers
- o Remote telecommunications access and data base services

Much of the information included was also provided by the Department to those participating in the networking conference; distribution of this type of information is an example of an important service the Department can provide to Alaska schools and districts which will facilitate their consideration of networking benefits.

For Additional Information

Considerably more information about educational networking and its potential in Alaska education was collected during this study than can profitably be transmitted in the report and its Appendix. The Office of Educational Technology and Telecommunications of the Department of Education would like to encourage anyone

with an interest in the study procedures, results, conclusions or recommendations to contact its project manager for the study.

The project staff can provide districts and schools with technical and cost information on educational networking components. The project collected brochures and specification sheets for most of the commonly used components that educators might use. The project staff can also provide speculation on the near future developments that might affect the practicality and cost of networking activities.

Ed Obie served as the Department of Education's project manager for this feasibility study. Readers with questions or comments about educational networking in general or this report in particular should contact:

Ed Obie, Project Manager
Office of Educational Technology
and Telecommunications
Alaska Department of Education
Pouch F
Juneau, Alaska 99811
907/465-2887

The Department was assisted in this project by Michael Hiscox and Evelyn Brzezinski of Interwest Applied Research.

INTERWEST
Applied Research

1500 S.W. Fifth Avenue, Suite 2405
Box 8189, University Station
Portland, Oregon 97207
(503) 223-3396

THE FEASIBILITY OF COMPUTER NETWORKING IN EDUCATION

A Presentation Made as a Part of the
ALASKA SMALL SCHOOLS CONFERENCE

Anchorage, Alaska—December 8, 1982

OUTLINE AND AGENDA

9:00 Welcome and Overview of Session

9:10 Discussion of the Department of Education's Current Networking Study

9:15 An Introduction to Microcomputer Networking
- o A definition of computer networking
- o Different types of networking and their applications
- o Advantages and disadvantages of networking in Alaska small schools
- o Equipment used in microcomputer networking
- o Networking costs and cautions
- o Implementing your own microcomputer network

9:50 Break

10:00 Question/answers about Networking Procedures and Uses

10:10 Objectives and Procedures for Small Group Sessions

10:15 Small Group Sessions

10:40 Summary and Questions

10:50 Adjourn

PRESENTERS

Ed Obie, Paul Berg—Alaska Department of Education
Michael Hiscox, Evelyn Brzezinski—Interwest Applied Research

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THE FEASIBILITY OF COMPUTER NETWORKING IN EDUCATION

DISCUSSION LEADERS' NOTES

INITIAL STEPS

Try to get the group to assemble quickly. Point out to participants the limited amount of time available for discussion. (You have only about 5 minutes for each of the questions on the right.) Try to convince them of the importance of their views about the usefulness of expanded computer to computer communications. Then give them a paraphrase of the overview below.

OVERVIEW

The technology needed to transfer information electronically has been available for a few years, but we are not yet an "electronic society." In fact, many experts have commented on the reluctance of business and government to take full advantage of the benefits electronic communications can provide. One theory is that people simply have no idea what they would do to make use of such a system were it available. And spending money for systems that have potential but solve no immediate problem is a questionable practice.

Before anyone can judge the value of computer networking for Alaska education, it is necessary to know what application would be made of such a system. The questions to be discussed are designed to make participants specify the uses they think could be made of an expanded electronic communications system.

DISCUSSION PROCEDURES

It is very important to cover all seven of the questions. Do not permit a long decision-making discussion. Instead, try to capture the consensus of the group; you don't need (and shouldn't try for) unanimous agreement on all points. For example, in questions 1-6, they are asked for three types of important information. Nothing prevents you from noting more than three types if they seem to have even modest support. You do not need to achieve any final list of three. You also do not need to order the information types unless such an ordering is readily apparent. Do not use up time trying to determine which of two information types is really most important. Keep the group moving and attempt to cover all questions. When the allotted time is up, have the groups come together again for closing comments.

NOTE TAKING

Use the chart on the following page to record information from your session. Write down both the answers to the discussion questions and comments made during the discussion which you think important. Write legibly; we may want to use these sheets in the afternoon session. When writing down answers to the questions, you may want to write down ideas as they are presented, then strike out those which find insufficient support.

Your final product is a completed chart giving the information types and comments. Do not plan on taking the chart with you to "tidy up" or "reorganize." Plan on turning this chart in at the close of the session.

THE FEASIBILITY OF COMPUTER NETWORKING IN EDUCATION

A Presentation Made as Part of the
ALASKA SMALL SCHOOLS CONFERENCE

Anchorage, Alaska—December 8, 1982

DISCUSSION GUIDE

Discussion Situation

It is a few years in the future. Numerous technological improvements have been made by the State of Alaska, the communications companies and local school districts. There is now no technical barrier to the rapid exchange of data by computers throughout the state. (Costs of transmitting information have also dropped somewhat, enough so that the cost of exchanging information should, for purposes of this discussion not be considered.) The task of the discussion groups is to identify the types of information that are most likely to be exchanged by educators in Alaska's schools and district offices using computers.

---

1. Data can now be sent FROM schools in each district TO district offices. What three types of information are most likely to be sent?

2. Data can now be sent FROM district offices TO schools in each district. What three types of information are most likely to be sent?

3. Data can now be sent FROM district offices TO the Department of Education. What three types of information are most likely to be sent?

4. Data can now be sent FROM the Department of Education TO district offices. What three types of information are most likely to be sent?

5. Data can now be sent FROM students in one school TO students in any other school in the state. What three types of information are most likely to be sent?

6. Alaska educators can now access numerous data bases from throughout the country. What three types of information are most likely to be obtained from these data bases?

7. The biggest advantage of electronic communications over written communications (i.e., the mail) is its increase in speed of delivering the information. For this advantage, one tolerates higher costs, more complexity, and limitations on the format of the information. First question—For what percent of the information transferred is electronic communication clearly superior? Second question—can anyone assign a monetary value (e.g., worth twice as much, three times as much) to the value of the instantaneous communications?

THE FEASIBILITY OF COMPUTER NETWORKING
IN EDUCATION

DISCUSSION RESULTS CHART

QUESTION 1	
INFORMATION TYPE	COMMENTS

QUESTION 2	
INFORMATION TYPE	COMMENTS

QUESTION 3	
INFORMATION TYPE	COMMENTS

QUESTION 4	
INFORMATION TYPE	COMMENTS

QUESTION 5	
INFORMATION TYPE	COMMENTS

(over)

QUESTION 6	
INFORMATION TYPE	COMMENTS

QUESTION 7	
SUPERIORITY?	MONETARY VALUE?

November 16, 1982

INTERWEST
Applied Research

1500 S.W. Fifth Avenue, Suite 2405
Box 8189, University Station
Portland, Oregon 97207
(503) 223-3396

Mr. Brad Raphel
Titled Director
Adak Region Schools
Adak Naval Station—Box 34
FPO Seattle 98791 (IntraAK)

Dear Mr. Raphel:

As you may know, the Twelfth Session of the Alaska Legislature appropriated money to study methods of networking the small computers used by Alaska schools. It is the responsibility of the Department of Education's Office of Technology and Telecommunications to provide the required data to the Legislature; Interwest Applied Research is assisting the Department with the study.

You may be aware that Interwest has already sent two surveys to samples of Alaska educators. The surveys ask for information about their plans and preferences for educational computing in Alaska. At the end of November, we will review the information to formulate some of the preliminary alternatives for networking procedures. We would like to have our preliminary findings discussed by the future users of such systems—people like yourself. To this end, Interwest and the Department will jointly sponsor a session on small computer networking at the Alaska Small Schools Conference being held in Anchorage, December 6th through 8th. The networking session will be held for two hours on the morning of Wednesday, December 8th, at the Anchorage Sheraton—the conference hotel. 1:00

Because of the role you and your district might play in making small computer networking a reality in Alaska education, I would personally like to invite you to attend this session. During the two hours, I will present some basic technical information about computer networking and will answer general questions. You will then be asked to participate in a small group session where you will have the opportunity to review the data collected by the surveys and influence the alternatives that will be proposed to the Legislature. You will also have the opportunity to have any questions you have about networking in your own situation answered by knowledgeable people.

I hope that you will be able to meet with us in Anchorage during the Small Schools Conference. Enclosed is a postage-paid card on which you should indicate whether you'll be able to participate in the Anchorage session. Please check the appropriate box and return to me as soon as possible. If you are able to join in these meetings, I can assure you that you will have the opportunity to have a major influence on the future of educational computing in Alaska. Please call me collect (503/223-3396) if you have any questions. I look forward to the possibility of working with you in Anchorage; thank you for your consideration.

Sincerely,

Michael D. Hiscox, Director

cc: John E. Savel, Superintendent

LISTING OF THOSE INVITED TO NETWORKING SESSION
——Morning Session Only——

Mr. Brad Raphel
Titled Director
Adak Region Schools
Adak Naval Station—Box 34
FPO Seattle 98791 (IntraAK)
cc: to John E. Savel, Superintendent

Mr. Roger Aylard
Vice Superintendent
Bering Strait Schools
Box 225
Unalakleet, Alaska 99684
cc: to Ron Hohman, Superintendent

Mr. Graham Ward
Teacher, Glennallen High School
Copper River Schools
Box 103
Glennallen, Alaska 99588
cc: to Alfred Krinke, Superintendent

Gordon Castanza
Director, Data Processing
Iditarod Area Schools
Box 105
McGrath, Alaska 99627
cc: to James Zuelow, Superintendent

Mr. Jerald Mikesell
Principal
Juneau Borough Schools
Box 808
Douglas, Alaska 99824
cc: to Michael Adams, Superintendent

Mr. Dennis Daggett
Vice Superintendent
Kenai Peninsula Borough Schools
Box 1200
Soldotna, Alaska 99669
cc: to Fred Pomeroy, Superintendent

Mr. Gardner Howes
Director, IMC
Kodiak Island Borough Schools
Box 886
Kodiak, Alaska 99615
cc: to Noreen Thompson, Superintendent

Ms. Carolyn Henderson
Coordinator, Staff Development
Mat-Su Borough Schools
Box AB
Palmer, Alaska 99645
cc: to Kenneth Kramer, Superintendent

Tom Jarvis
Mathematics Instructor
Nome City Schools
Box 131
Nome, Alaska 99762
cc: to Larry LaBolle, Superintendent

Mr. Don Zundel
Teacher, Petersburg Elementary
Petersburg City Schools
Box 289
Petersburg, Alaska 99833
cc: to Harry Rogers, Superintendent

Mr. Gary Short
Teacher, Baranof Elementary School
Sitka Borough Schools
Box 179
Sitka, Alaska 99835
cc: to Authur Woodhouse, Superintendent

William Phillips
Superintendent
Lower Yukon Schools
Box 200
Mountain Village, Alaska 99632

Wayne B. Fagg
Superintendent
Northwest Arctic Schools
Box 51
Kotzebue, Alaska 99752

Thomas Aubertine
District Testing Representative
Southeast Island Schools
Box 8340
Ketchikan, Alaska 99901
cc: to Robert Weinstein, Superintendent

Allen McCurry
Media Specialist
Yukon/Koyukuk Schools
Box 367
Nenana, Alaska 99760
cc: to Joe Cooper, Superintendent

Jim Barnett
Superintendent
Lake and Peninsula Schools
Box 119
Naknek, Alaska 99633

LISTING OF THOSE INVITED TO NETWORKING SESSION
——Morning and Afternoon——

Spike Jorgensen
Superintendent
Alaska Gateway Schools
Box 226
Tok, Alaska 99780

Chuck Williams and Norm Holthouse
Management Information Systems
Anchorage Public Schools
Pouch 6-614
Anchorage, Alaska 99503
cc: to E. E. Davis, Superintendent

Ms. Loretta Cross
Grants Manager
Fairbanks North Star Borough Schools
Box 1250
Fairbanks, Alaska 99701
cc: to Dr. Kenneth S. Burnley, Superintendent

Ms. Ann Collins
District Computer Coordinator
Lower Kuskokwim Schools
Box 305
Bethel, Alaska 99559
cc: to Carl Peterson, Superintendent

Mr. Samuel Bushon
Titled Coordinator
North Slope Borough Schools
Box 169
Barrow, Alaska 99723
cc: to Don Renfroe, Superintendent

Ms. Kathleen Formella
Title Coordinator & Curriculum Specialist
Railbelt Schools
Drawer 129
Healy, Alaska 99743
cc: to Jim Paul, Superintendent

Mr. Charlie Arteaga
Counseling & Guidance
Ketchikan Gateway Schools
Pouch Z
Ketchikan, Alaska 99901
cc: to Darroll Hargraves, Superintendent

Ms. Kathy Wayne
Reading Specialist
Wrangell City Schools
Box 651
Wrangell, Alaska 99929
cc: to Robert McConnell, Superintendent

Mr. Ben Cherry
Instructor
Southwest Region School District
Pouch 196
Dillingham, Alaska 99576
cc: to Peter Flisock, Superintendent

Bob McHenry
Superintendent
Kuspuk Schools
Box 108
Aniak, Alaska 99557

INTERWEST
Applied Research

1500 S.W. Fifth Avenue, Suite 2405
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Portland, Oregon 97207
(503) 223-3396

December 6, 1982

MEMORANDUM

To: Networking Conference Participants

From: Michael D. Hiscox, MDH Meeting Coordinator

Subject: December 8th Networking Meeting

Interwest Applied Research and the Department of Education are pleased you will be participating in our meeting on computer networking. The schedule for the Wednesday meeting is as follows:

9:00-10:50	Preliminary session on networking (open to conference)
11:00-1:00	On your own for lunch
1:00-4:00	Networking planning meeting (invitational)

The 4:00 p.m. ending time for the afternoon session is approximate; the actual time will depend on the complexity of the discussions. We will be beginning all meetings on time, so please be prompt. The meetings will be held in of the Sheraton hotel. Please contact me at the Sheraton (Room) if you have any questions. We look forward to working with you. Thanks.

MDH/hs

December 6, 1982

INTERWEST APPLIED RESEARCH

Paired Comparison Survey

Educational Computing in Alaska

Question	Total	Preferred Yes	Preferred No
1. Obtain computer software for instructional use	697	7	1
2. Receive more staff training in computers and computer use	683	6	2
3. Obtain microcomputer hardware for instructional use	614	8	0
4. Obtain microcomputer hardware for administrative use	419	3	5
5. Obtain computer software for administrative use	367	4	4
6. Improve the quality of instructional TV/film/video available to schools	329	2	6
7. Transfer information by computer among schools and district offices	324	3	5
8. Transfer information by computer among schools/district offices statewide	303	2	6
9. Transfer information by computer between state and schools/district offices	257	1	7

			1	2	3	4	5	6	7	8	9
1. Obtain micro hardware for instructional use.				▽	▽	▽	▽	▽	▽	▽	▽
2. Obtain micro hardware for administrative use.			102/9 △		△	▽	△	▽	△	▽	△
3. Obtain computer software for administrative use.			94/17 △	48/62 ▽		△	△	▽	▽	▽	△
4. Improve quality of instructional TV/Films/video available to schools			89/24 △	58/53 △	55/56 ▽		△	△	▽	△	△
5. Receive more staff training in computers and use.			58/63 △	15/95 ▽	23/88 ▽	16/95 ▽		▽	▽	▽	△
6. Transfer information by computer between schools and district offices.			95/16 △	57/53 △	57/53 △	54/55 ▽	94/19 △		▽	△	▽
7. Transfer information by computer between state and schools/district offices.			92/19 △	63/47 △	68/42 △	56/54 △	87/14 △	74/36 △		△	△
8. Transfer information by computer among schools/district offices statewide.			92/18 △	57/53 △	73/37 △	54/55 ▽	99/12 △	70/40 △	33/75 ▽		△
9. Obtain computer software for instructional use.			57/54 △	12/98 ▽	12/99 ▽	16/95 ▽	47/64 ▽	18/93 ▽	12/98 ▽	14/96 ▽	

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SECTION 1

Summary Survey
A/O 12/6/82

FILL IN THE BLANK WITH THE APPROPRIATE INFORMATION OR CIRCLE YES, NO, OR ?(for Don't Know)

	District Office	"Representative" Building
Number of students (enter district enrollment under "District Office")	2,762 Avg.	218 Avg
Number of phone lines into building	6 Avg	2 Avg
Are any existing phone lines mostly unused?	24% Yes ? No 76%	6% Yes ? No 94%
Do you consider the telephone service reliable?	85% Yes ? No 15%	76% Yes ? No 23%
Are there problems of "breakup" or "echo" of telephone signals?	59% Yes ? No 41%	69% Yes ? No 31%
Does the building receive a television signal?	86% Yes ? No 14%	83% Yes ? No 17%
How many Apple II microcomputers are available?	12 in total/district	5
How many other microcomputers are used for instructional purposes?	1 in total district	0
How many other microcomputers are used for administrative purposes?	1 in total district	0
Are there enough printers for the microcomputers?	75% Yes ? No 25%	56% Yes ? No 44%
Do the microcomputers have enough storage (disk drives) available?	100% Yes ? No —	92% Yes ? No 8%
Are modems readily available for sending messages?	79% Yes ? No 21%	35% Yes ? No 65%
Is there a microcomputer available that uses the CP/M operating system?	64% Yes ? No 36%	17% Yes ? No 83%
Is there a staff member in the building who:		
-- Can use a modem to send a message?	81% Yes ? No 19%	67% Yes ? No 32%
-- Can write a good instructional program?	63% Yes ? No 37%	65% Yes ? No 35%
-- Can write a good administrative program?	53% Yes ? No 47%	53% Yes ? No 47%
-- Keeps abreast of the latest small computer developments?	62% Yes ? No 38%	65% Yes ? No 35%
-- Can perform simple maintenance of microcomputer equipment?	67% Yes ? No 33%	63% Yes ? No 37%
-- Understands computer terms such as parity, stop bit and baud rate?	63% Yes ? No 37%	71% Yes ? No 29%

Average is not meaningful due to impact of Anchorage, etc. Number given is approximate median

Is there a central computer that serves district-wide functions? If so, please specify. 63% yes; 37% no

Does your district use an external computing service? If so, please specify. 54% yes; 42% no

SECTION 2

Indicate your agreement with each of the statements using the following scale. Put your response in the space ( ).

1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree 7=Don't Know or Not Applicable

4.50 ( ) If we could send messages via computer to schools and district offices statewide, we would do so.

4.33 ( ) Any computer network must allow students to be able to send messages to other schools in the state.

4.14 ( ) Better communications (district and statewide) would improve educational quality in our district.

3.75 ( ) Our district makes good use of the existing Electronic Mail System (EMS).

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4.27 ( ) We plan to buy more computer equipment for instructional use.

3.91 ( ) We plan to buy more computer equipment for administrative use.

3.23 ( ) We would like more guidance from the Department (of Education) on what equipment we should purchase.

3.45 ( ) We would like more guidance from the Department on what instructional software we should purchase.

3.64 ( ) We would like more guidance from the Department on what administrative software we should purchase.

4.05 ( ) We would like the Department to provide more software for our use.

4.18 ( ) We would like to receive more computer-related staff training.

1.91 ( ) Administrative uses of computers are more important than instructional uses in our district.

3.53 ( ) It would be useful to be able to send information by computer between the district office and our schools.

2.27 ( ) We have sufficient resources (staff and money) for any computerized <u>instructional</u> system we need.

2.05 ( ) We have sufficient resources (staff and money) for any computerized <u>administrative</u> system we need.

1.82 ( ) It is easy for district staff to keep up on the latest developments in educational computing.

SECTION 3

Begin this task with 100 points. Divide the 100 points to show the relative AMOUNT OF INFORMATION TRANSFER between each pair of points listed. Information transfer includes information passed by telephone, U.S. Postal Service, intra-district mail, EMS, etc. It includes information transfer both from administrative offices as well as from individual students and staff. There are ten pairs of locations--if there were equal information passed between all pairs, each would receive 10 points. Your total assignments must equal 100. Perform the task twice. First assign points for the CURRENT situation. Then assign points for the IDEAL situation; the ideal situation assumes there are no cost or technical factors to restrict your information transfer. Consider all the information to be transferred, not just information that is or could be transferred by computer. Call (503)223-3396 if you have any questions about this section.

	CURRENT	IDEAL
AMOUNT OF INFORMATION TRANSFER FROM:		
Schools in your district to schools and districts statewide	4.73	6.45
Schools and districts statewide to schools in your district	11.32	6.67
Your district office to schools in your district	12.95	10.63
Schools in your district to your district office	16.77	16.19
Your district office to State agencies (DOE and others)	14.09	12.48
State agencies to your district office	15.91	11.52
Your district office to schools and districts statewide	7.50	7.67
Schools and districts statewide to your district office	7.18	7.19
Schools in your district to State agencies	5.00	5.76
State agencies to schools in your district	6.05	7.00
TOTAL	100	100
	97.50	99.53

→ Totals do not equal 100 due to incorrect addition by respondents

Call (503) 223-3396 collect if you have questions about this survey. Be sure to mail it by November 15th. Information about the results of this survey will be available in January. Thank you for your help.

THE FEASIBILITY OF COMPUTER NETWORKING IN EDUCATION

A Presentation Made as Part of the
ALASKA SMALL SCHOOLS CONFERENCE

Anchorage, Alaska—December 8, 1983

*Presented By:

Office of Educational Technology
and Telecommunications
Alaska Department of Education
Pouch F—Gold Belt Building
Juneau, Alaska 99811

Project Staff: Ed Obie, Paul Berg

and

Interwest Applied Research
Box 8189, Univesity Station
Portland, Oregon 97207

Project Staff: Michael Hiscox, Evelyn Brzezinski

THE FEASIBILITY OF COMPUTER NETWORKING
IN EDUCATION

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A PARTIAL SOURCE LIST FOR EDUCATIONAL NETWORKING

IMPORTANT NOTE

The companies and products listed below are examples of those which may be valuable to Alaska educators considering computer networking. This list is not complete; many companies offering valuable products and services are not listed. No endorsement of any kind is made for those companies listed by either the Alaska Department of Education.

Corvus Systems
2029 O'Toole Avenue
San Jose, California 95131
(408) 946-7700
Products: Hard disks, disk backup, boards, control software
Systems: Wide variety, including special products for Apple II

Keybrook Business Systems
2035 National Avenue
Hayward, California
(415) 887-8999
Products: Hard disks, disk backup, control software
Systems: Any CP/M

Orchid Technology
487 Sinclair Frontage Road
Milpitas, California 95035
(408) 942-8660
Products: Boards, control software
System: IBM Personal Computer

Nestar Systems, Inc.
2585 East Bayshore Road
Palo Alto, California 94303
(415) 493-2223
Products: Boards, hard disks, disk backup, control software
Systems: Apple II, Apple III, IBM PC, also combined Apple and IBM PC

Norvell Data Systems
1170 North Industrial Park Drive
Orem, Utah 84057
(801) 226-8202
Products: Hard disks, boards, control software
Systems: Any CP/M

Softworks, Inc.
14805 N. 73rd Street, Suite J
Scottsdale, Arizona 85260
(602) 998-3986
Products: Boards, control software
System: Apple II

Software Connections
1800 Wyatt Drive, Suite 17
Santa Clara, California 95054
(415) 988-3704
Product: Control software
System: Apple II with Corvus Omninet

Axlon, Inc.
70 Daggett Drive
San Jose, California 95131
(408) 730-0216
Product: Portable communications terminal
Systems: Any system with proper configuration

Tymshare, Inc.
20705 Valley Green Drive
Cupertino, California
(408) 446-6000
Products: Terminals, electronic mail, access to information services
Systems: Any system with proper configuration

BRS Information Services
1200 Route 7
Latham, New York 12110
(518) 783-1161
Product: Database access
System: Any terminal/computer with proper configuration

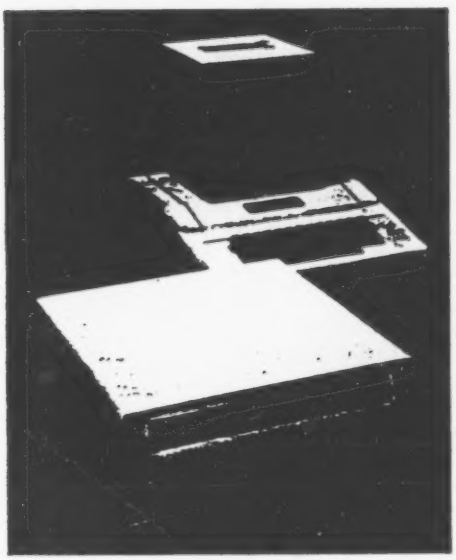
Source Telecomputing
1616 Anderson Road
McLean, Virginia 22102
(800) 336-3366
Products: Database access, timeshared computing, electronic mail
Systems: Any terminal/computer with proper configuration

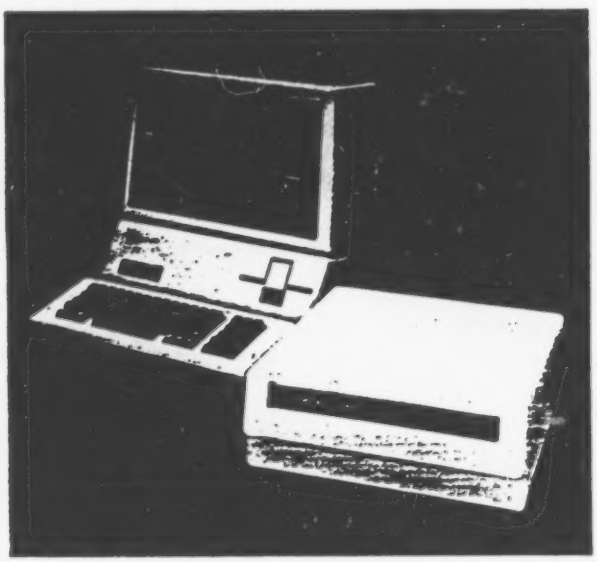
CompuServe
5000 Arlington Centre Blvd.
Columbus, Ohio 43220
(800) 848-8990
Products: Database access, timeshared computing
Systems: Any terminal/computer with proper configuration

Woolf Software Systems
23842 Archwood Street
Canoga Park, California 91307
(213) 703-8112
Products: Control software for data transfer
Systems: Any CP/M, IBM PC

CORVUS SYSTEMS

Winchester Disk Systems for the APPLE II AND APPLE III PERSONAL COMPUTERS





EXTEND YOUR APPLE LIMITS

Cost-effective mass storage systems from Corvus give Apple® computers the power they need to perform today's serious microcomputer applications.

Available in 6, 11, or 20 megabyte versions, Corvus Winchester disk systems let you match your data system requirements to your budget. You can start with a single 6 megabyte system, then add on up to three additional Winchester disk systems in any combination as you need additional storage capacity. Corvus Winchester disk systems are also compatible with our Omninet and Multiplexer local area networks. Using these networks, up to 64 stations can share a common data base and other peripherals. With the Corvus Mirror™ you can also support your disk system with economical video tape backup.

PROVEN WINCHESTER TECHNOLOGY

All Corvus Winchester disk systems offer the Apple user the established reliability of Winchester disk technology. Low mass read/write heads allow substantial reduction in the distance between the head and the surface of the media. Yet, the heads never actually touch the surface of the media, thereby improving system dependability. The disk drive itself is enclosed in a sealed environment with a recirculating air system to keep dust, smoke, and other foreign particles from reaching the disk surface. Because of the inherent reliability of the Corvus design, these units require no preventive maintenance. Tens of thousands of these systems are in daily use worldwide.

CORVUS INTELLIGENT CONTROLLER

The heart of the Corvus Winchester disk system is its intelligent controller. This microprocessor-based controller provides rapid, reliable access to the data base while minimizing its software requirements from your Apple. The controller manages bi-directional data transfer between the disk drive and the CPU interface, translates high-level command sequences into a form intelligible to the disk drive, and performs a number of functions to insure accurate data transfer. These functions include read-after-write verify, automatic error retries, transparent formatting with CRC (Cyclic Redundancy Check) error detection, and high-speed transfer using DMA (Direct Memory Access).

CORVUS SYSTEMS

Winchester Disk Systems for the APPLE II AND APPLE III PERSONAL COMPUTERS

CORVUS SOFTWARE

The ROM-resident software is interfaced to Apple DOS 3.3, Apple CP/M, and Apple Pascal for the Apple II as well as to SOS 1.1 for the Apple III. Data from any of these operating systems may reside on a single drive by dividing the disk space.

The DOS 3.3 interface treats all or part of the mass storage system as multiple images of a standard diskette. The DOS syntax which is normally used to check volumes is used with the Corvus software in DOS to specify which volume to access. Up to 134 separate volumes can be on line at one time, and any of these volumes may be write-protected at will.

The Apple Pascal interface features flexible management of the mass storage space. Volumes of varying size can reside on one system, and these volumes can be created, removed, or write-protected at any time. In fact, you can even configure the system as one volume of up to 8 megabytes if you wish. Any UCSD/Apple Pascal program may use the 8 megabytes without modification. Corvus provides over a dozen utilities programs to make your use of the system much easier.

OTHER CORVUS COMPATIBLE COMPUTERS

In addition to the Apple II and III, Corvus disk systems are available for most other popular microcomputers. The list includes the IBM Personal Computer, the Xerox 820, TRS-80 Models I, II, and III, Zenith Z89/H89 and Z90, NEC PC 8001, S-100 Bus (such as Cromemco, North Star, and Vector Graphic), Atari 800, Commodore, and the SuperBrain. Ask your Corvus dealer for details.

WARRANTY AND SERVICE

All Corvus disk systems come with a six (6) month parts and labor warranty. Warranty extensions of up to 24 months are available at a reasonable extra cost. If your Corvus disk system should ever require service, it may be taken to one of our authorized service centers throughout the world.

Atari 800 is a trademark of Atari, Inc.
Apple is a registered trademark of Apple Computers, Inc
Xerox and 820 are trademarks of Xerox Corporation
TRS-80 is a registered trademark of the Tandy Corporation
SuperBrain is a trademark of Intertec Data Systems
Cromemco is a trademark of Cromemco, Inc.
North Star is a trademark of North Star Computers, Inc.

Specifications

DATA ORGANIZATION	6 MB	11 MB	20 MB
Capacity (megabytes)			
Unformatted	6.7	11.3	20.5
Formatted	5.7	10.8	19.7
Disks			
Number	2	2	3
Data Surfaces	4	3	5
Diameter (inches/centimeters)	5.25/13.3	8/20.32	8/20.32

PERFORMANCE	6 MB	11/20 MB
Access Times (milliseconds)		
Minimum	43	6
Maximum	240	65
Average	125	35
Latency Time		
Average (milliseconds)	6.25	8.33
Disk Rotational Speed (RPM)	4,800	3,600
Peak Transfer Rate (kilobytes/second)	960	648

PHYSICAL DIMENSIONS	6 MB	11/20 MB
Height (inches/centimeters)	5.75/14.6	6.375/16.19
Width (inches/centimeters)	12.0/30.5	14.50/36.83
Depth (inches/centimeters)	15.0/38.1	23.00/58.42

ENVIRONMENTAL SPECIFICATIONS	
Temperature (°F/°C)	
Operating	50° to 120°/10° to 50°
Non-operating	−40° to 140°/−40° to 60°
Variation	18°/10° per hour
Humidity (non-condensing)	
Operating	10 to 80%
Non-operating	10 to 90%
Altitude, Operating (feet/meters)	−1,000 to 10,000/−305 to 3,050

POWER REQUIREMENTS		
Voltage	110/120 or 220/240 volts (selectable) 50/60 Hz, single phase alternating current	
Consumption	6 MB:	125 volt amperes
	11/20 MB:	250 volt amperes

Corvus reserves the right to change specifications without notice or obligation.

CORVUS SYSTEMS
2029 O'Toole Avenue/San Jose, California 95131
Telephone (408) 946-7700
TWX 910-338-0226

Printed in U.S.A.—3-82

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CORVUS SYSTEMS

OMNINET™ LOCAL NETWORK
TECHNICAL OVERVIEW

The OMNINET local network supports up to 64 devices sharing a simple RS-422 twisted pair of wires up to 4000 feet in length. It transfers data at the rate of 1 million bits per second.

TRANSPORTER INTERFACES

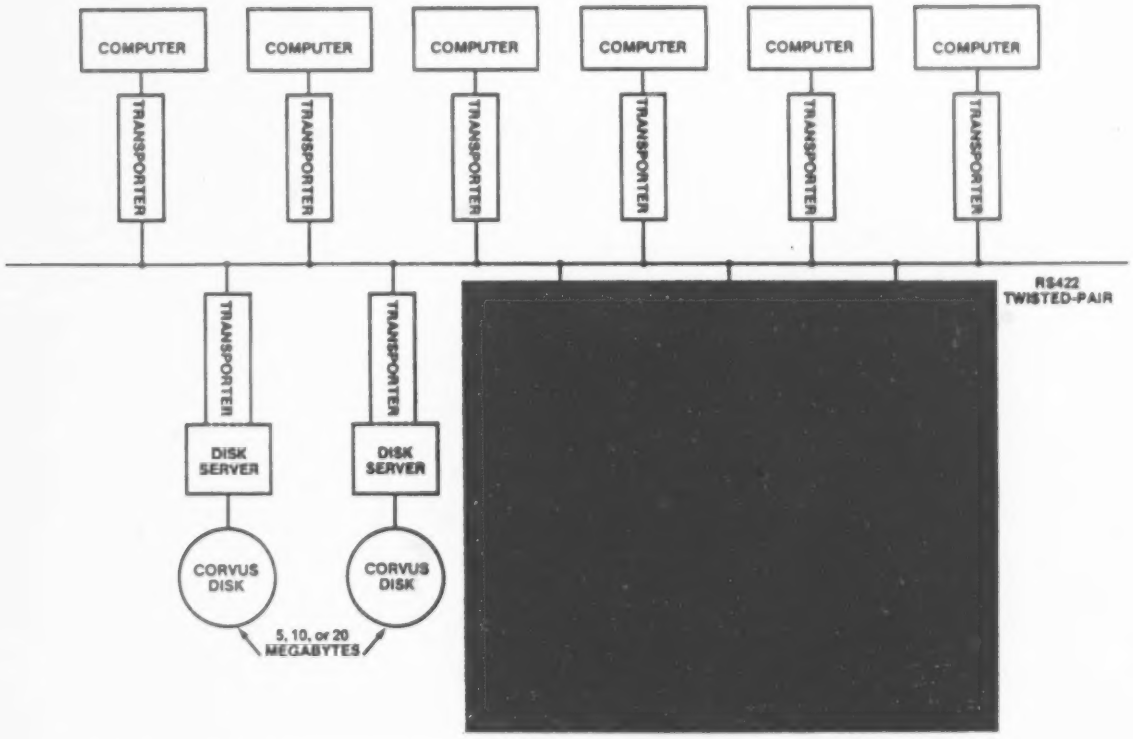
Each device attached to the OMNINET local network has an interface controller called a transporter. The transporter utilizes a Motorola 6801 microprocessor, a custom gate array integrated circuit to control high speed direct memory access (DMA) data transfers, and associated support components.

The transporter interfaces directly to both the RS-422 serial line and the host computer's memory. Transfer of data to or from the host computer is performed without intervention by host software. Because the data transfer is handled by the transporter and data buffering is not required, high speed data transfers are possible while maintaining a low cost network interface.

NETWORK CONTROL

The OMNINET local network is a distributed control network and hence, no master controller is required. Network control is assumed by any transporter which has a message to send as soon as the network is available.

OMNINET LOCAL NETWORK



Since OMNINET is a shared access local network that allows any device to transmit at any time, a collision avoidance scheme is implemented in the transporters. Collision avoidance is performed using a combination of two methods. First, the popular Carrier Sense Multiple Access (CSMA) mechanism is utilized to determine when the network is available and second, the transporter computes a randomized transmit start time to minimize the probability of two devices trying to access an available network at the same time.

Unlike many other local networks, OMNINET does not require a collision detection mechanism. This allows OMNINET to be implemented on an RS-422 twisted pair of wires and eliminates the cost associated with collision detection hardware.

AUTOMATIC ERROR DETECTION AND CORRECTION

Error detection, and retransmission activities are performed by the transporters without software intervention. Thus, the host software burden is substantially reduced while overall system performance is improved. OMNINET utilizes a positive acknolwedgment method to insure that a message has reached its destination without error. If a positive acknowledgment is not received for a message, retransmission is automatically performed by the transporter until it is successful, or a user-specified number of retries have been performed. If transmission is unsuccessful, the sending host is informed as to the nature of the error.

FLEXIBLE DEVICE ADDRESSING

Device addressing within the OMNINET local network allows a message to be sent to any device attached to the network or a message broadcast to all devices on the network. In addition to device addressing, OMNINET supports sockets. A socket provides additional addressing capability by allowing a message to be sent to a particular buffer in the selected host microcomputer. Four sockets can be defined for each device to aid in the separation of different types of messages within the host computer.

TRANSPORTER COMMANDS

The transporter accepts two major categories of commands from the host computer to control the overall flow of messages within the local network. The two major categories are:

- Send Mesage
- Receive Message

The send message command transmits a message up to 600 bytes in length to any designated host socket. The send message command includes a command code, a result address, a destination host socket number, the message address and length, and an optional message header up to 255 bytes in length. The transporter utilizes DMA to transfer the message and optional message header without additional host software involvement. When the message is delivered, the result status code is set to reflect the status of the transmitted message. Some of the possible results are:

- Message delivered successfully
- Message failed after 'n' retries
- Receiving socket not set up
- Message too long for receiving socket

Receive message commands prepare host sockets to receive incoming messages. The receive message command includes a command code, a result address, a socket number, a data buffer address and maximum message length. The optional message header length is also specified.

When the optional message header is utilized, the header and the actual message can be placed into different locations within the host's memory. This feature allows device drivers to place the message data directly into the user's buffer while placing the header information in the driver's buffer, thus eliminating the need for the driver to move the message data to the user's buffer.

NETWORK PROTOCOLS AVAILABLE

Various types of network protocols can be implemented using the OMNINET local network. Corvus Systems has implemented its field-proven CONSTELLATION software protocol on the OMNINET local network. The CONSTELLATION software allows multiple computers to share a Corvus disk system. A special disk server device is utilized with the CONSTELLATION software when the OMNINET local network is used. The disk server appears as just another device on the local network to the OMNINET network but performs disk sharing for the other computers on the network. The disk server contains both a transporter network interface and a Corvus disk system interface. Additional shared peripherals will be added to the OMNINET local network in a similar manner.

SPECIFICATIONS

Data Rate:	1 million bits per second
Total Network Length:	4,000 feet (1.21 km)
Number of Devices:	Up to 64
Message Size:	Variable, up to 2 kilobytes
Network Medium:	RS-422 twisted pair wire

CORVUS SYSTEMS

2029 O'Toole Avenue, San Jose, California 95131
Telephone (408) 946-7700 TWX 910-338-0226

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CORVUS COMPATIBLE SOFTWARE DIRECTORY

This directory provides a sampling of the software programs which can be used with the Corvus Winchester Hard Disk Drives. Most of the non-copy protected software written to run under the CP/M, TRSDOS 2.0 for TRS-80 MOD II, NEWDOS/80 ver. 2.0, Apple DOS 3.3 and Apple Pascal operating systems will load easily from a floppy diskette and run on the Corvus Hard Disk. Some software packages that are copy protected, like DB Master, will reside in the floppy drive while utilizing the increased storage capacity and access speed of our hard disk drives in the storage and retrieval of data.

The software packages whose names are followed by three asterisks "***" have special hard disk versions available. Many of these hard disk versions often have extra convenience features added to take advantage of the vastly increased access speed and mass storage provided by the Corvus Winchester Hard Disks.

Apple DOS 3.3 and Pascal

Three types of problems with Corvus software compatibility under Apple DOS 3.3 have come to light.

1. Software compatibility problems stem mostly from the addition of 80-column cards, communication cards, memory boards, interface cards and any of the large number of printed circuit cards available to plug into the slots inside the Apple computer. Some of these cards have been found to compete with our Corvus Hard Disk interface card for the same few memory spaces in low memory not used by the operating system. More information on specific cards which interfere with the Corvus interface will be available in the next edition of the CORVUS SYSTEMS SOFTWARE DIRECTORY.

2. Software designed to access multiple floppy diskettes may not work if the developer did not take into account the Corvus simulation of floppy diskettes through volume numbers.

3. There are a few software packages that require booting from a diskette in slot #6 (where the Corvus interface card must reside). Switching the diskette and Corvus Hard Disk interface cards is both bothersome and risks damage to the computer and the cards should one forget to turn off the Computer before swithing the cards. There are two very good accesory cards designed to alleviate this problem.

1. The Johnson SLOT SWAPPERS available from Johnson Associates will swap slot #6 with any other slot with the flick of a toggle switch.

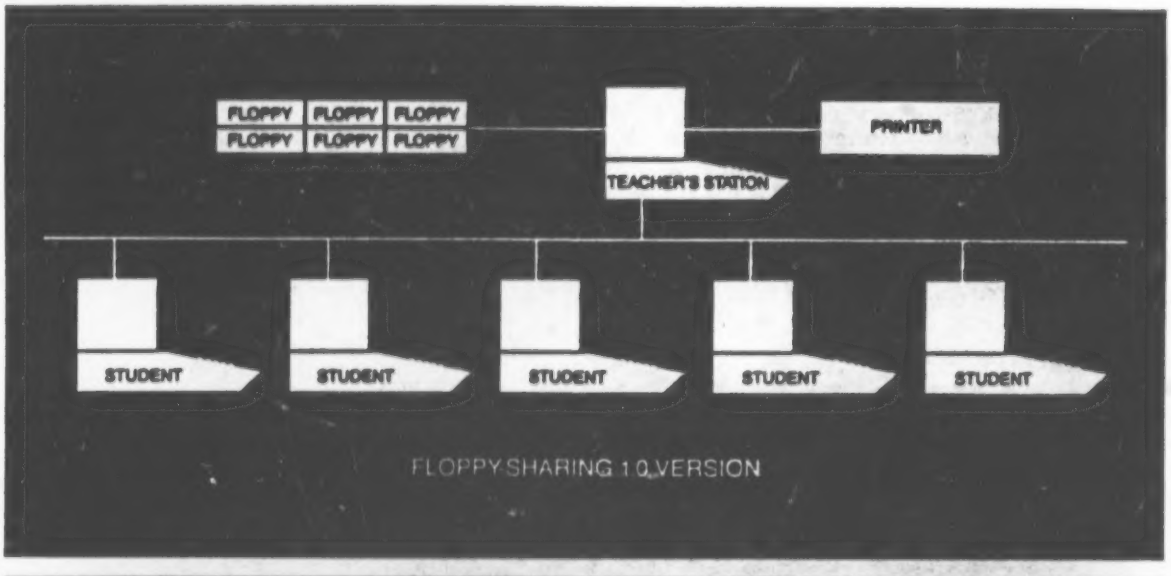
2. The SLOT SWAPPER JG 4X6 from Microbyte swaps slots 4 and 6 in software via a poke command.

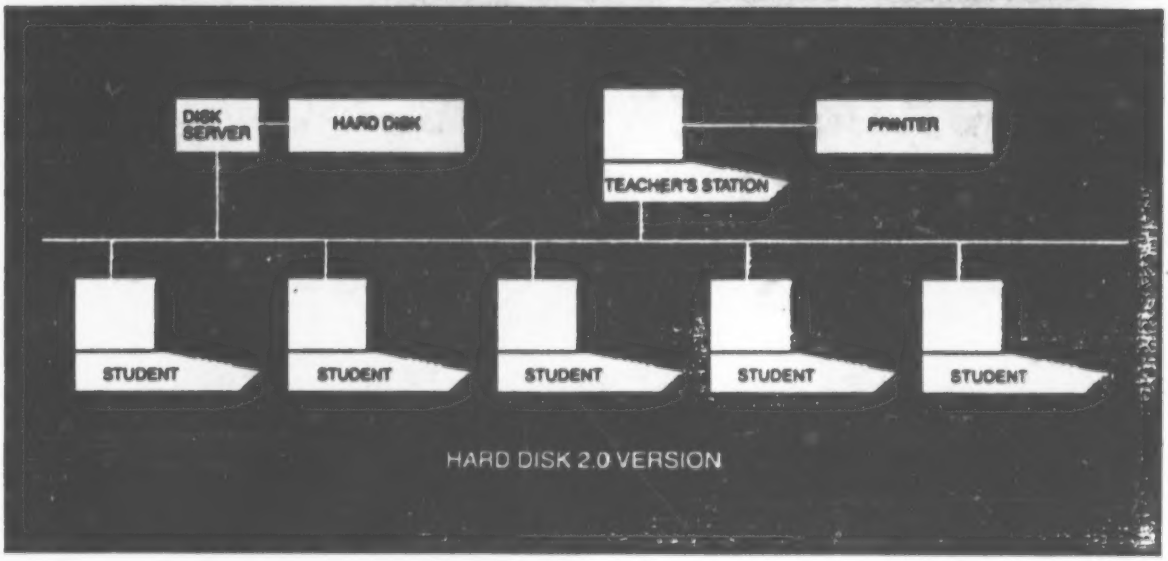
Johnson Associates
6525 w. Villa Theresa
Glendale, AZ 85308
(602) 979-4554

Microbyte
Nazas 10-2
Col.Cuahtemoc
Mexico city, Mexico 06400
(905)591-0321

[illegible]DV AVAILABLE

THE CLASSROOM MONITOR





NETWORK SYSTEMS FOR APPLE II COMPUTERS

The CLASSROOM MONITOR software system turns your teacher's APPLE into a versatile network controller and monitor. For both hard disk and floppy-sharing networks, the CLASSROOM MONITOR lets you manage your classes more efficiently.

Software Connections

THE CLASSROOM MONITOR

FLOPPY-SHARING VERSION 1.0

FEATURES

FLOPPY-SHARING VERSION
- From 1–6 Shared Access Drives
- Diskette Password Protection
- DOS 3.3 Compatible

TEACHER CONTROLLED DOWNLOADING
- BASIC Programs

DISPLAY-SHARING
- PEEK Command
- DEMO Command

PRINTER-SHARING

HIGH SPEED OMNINET NETWORK
- 1 Megabit Data Rate
- 2000 feet Max Cable Length
- 64 APPLE IIs Max

HARDWARE REQUIREMENTS

Teacher's Station
- APPLE II PLUS (48K with 16K RAM card)
- OMNINET Interface card
- Monitor (video display only)
- Printer (optional)
  (APPLE compatible)
- DISK II (1-6 drives)

Student's Station
- APPLE II (32/48K)
- OMNINET Interface card
- Monitor (video display only)
- DISK II (optional)

HARD DISK VERSION 2.0

FEATURES

HARD DISK VERSION
- Requires CORVUS Hard Disk and Disk Server
- DOS 3.3 Compatible
- APPLE PASCAL Compatible

TEACHER CONTROLLED DOWNLOADING
- BASIC Programs
- DOS 3.3 Binary Programs
- PASCAL Programs

DISPLAY-SHARING
- PEEK Command with Auto-scan
- DEMO Command
- Low Resolution Graphics

PRINTER SPOOLING

HIGH SPEED OMNINET NETWORK
- 1 Megabit Data Rate
- 2000 feet Max Cable Length
- 63 APPLE IIs Max

STATION-TO-STATION MESSAGES
- TALK Command
- OMNITALK Utility

HARDWARE REQUIREMENTS

Teacher's Station
- APPLE II PLUS (48K with 16K RAM card)
- OMNINET Interface card
- Monitor (video display only)
- Printer (optional)
  (APPLE compatible)

Student's Station
- APPLE II (32/48K)
- OMNINET Interface card
- Monitor (video display only)

Corvus Hard Disk & OMNINET Disk Server

APPLE is a registered trademark of Apple Computer Inc.
OMNINET is a registered trademark of Corvus Systems, Inc.

For the name of the dealer nearest you, call or write:

SOFTWARE CONNECTIONS, INC.
1800 WYATT DRIVE, SUITE #17
SANTA CLARA, CA 95054, (408) 988-3704

Software Connections

Software for Personal Computer Networks

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KEYBROOK'S APPROACH TO LOCAL AREA NETWORKS

CHECK THE DIFFERENCES!!!

√ The Network (LAN)

Made up of economical, 4-strand telephone wire, the KEYBROOK network offers sophisticated CS/MA/CD protocol that can support up to 32 connections (nodes) per 2000 feet. Simple installation requires a standard RJ-11 jack for each node, inserted along the network wire in convenient locations.

√ The FileServer

An intelligent disc unit that makes up one of the connections on the network, and offers a mini-computer environment complete with file and record and locking capabilities. File and Directory control is maintained within the FileServer, allowing any CP/M microcomputer to become a workstation on the network.

√ The PrintServer

Allows line and character printers to be shared among workstations. Printing jobs are spooled to the disc, and the PrintServer constantly checks for files that are ready to print.

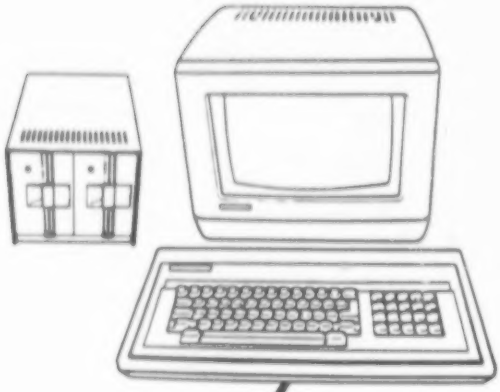
√ The Difference

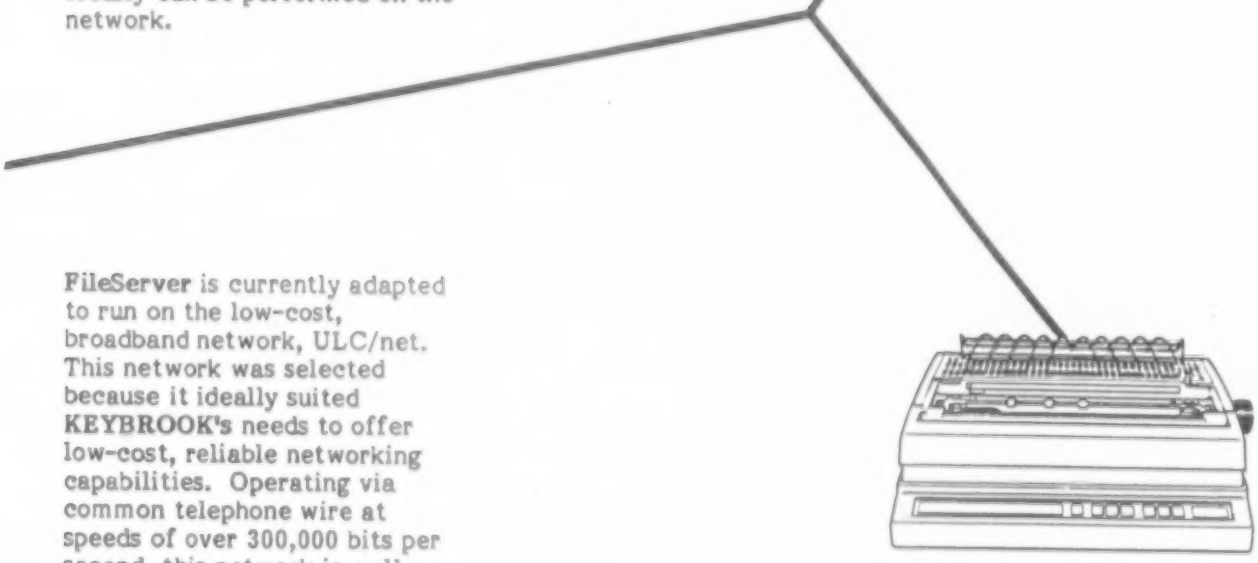
Other networks for microcomputers offer less intelligent disc servers, incapable of preventing file and directory collisions. Since KEYBROOK places intelligence in each of the server boxes, each microcomputer maintains its computing power locally, and gains access to files in a central storage repository, where they are protected by the resident software.

WATCH FOR MORE SERVER PRODUCTS

2035 National Ave., Hayward, CA 94545 (415)887-8999

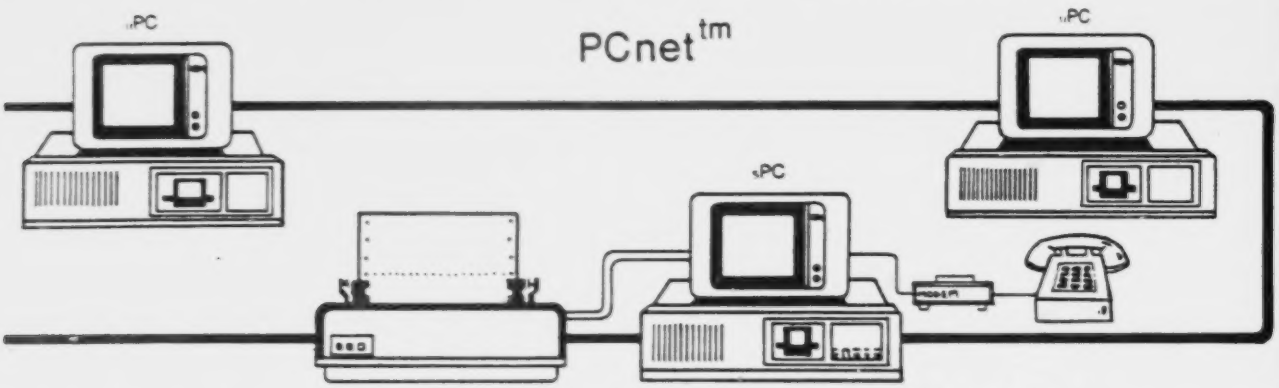
The **KEYBROOK FileServer** contains a Z80A microprocessor with 64K RAM, 4K ROM, as well as a disc storage unit. All of the software to control a user's access of the disc is handled by the **FileServer. FileServer** offers a high level of sophistication to a network by responding to workstation requests on a "file" basis rather than a "physical" sector address which is common to "disc servers". Any computer capable of running Digital Research's CP/NET can access data from the **FileServer.** CP/NET is an existing software package that was produced to allow microcomputers running CP/M to have access to disc files and other resources running under MP/M. As such, it was the perfect vehicle to provide access to **FileServer.** Under this system, once a logical unit is defined as remote, all subsequent accesses actually go to the **FileServer** so that any process that can be performed locally can be performed on the network.





FileServer is currently adapted to run on the low-cost, broadband network, ULC/net. This network was selected because it ideally suited **KEYBROOK's** needs to offer low-cost, reliable networking capabilities. Operating via common telephone wire at speeds of over 300,000 bits per second, this network is well-suited to the hard-disc-based **FileServer.**

Orchid Technology PCnet™ Local Area Network for the IBM Personal Computer



The Orchid Technology PCnet is the first Local Area Network designed specifically for the IBM Personal Computer and its MS-DOS Operating System. PCnet provides low system cost, high performance, and a transparent MS-DOS interface that is powerful yet easy to use.

PCnet will be available on other MS-DOS machines in the future.

LOCAL NETWORKING BENEFITS

There are several good reasons to interconnect microcomputers via a high speed local network. First, a network allows expensive resources such as hard disk units and letter quality printers to be shared, thus reducing the per station cost. Second, it is convenient to share files, programs, etc. among several cooperating users. If users keep all files on a shared disk, there is also the convenience of centralizing backup facilities and procedures. Finally, networking increases the range of applications that can be handled by inexpensive microcomputers.

This last point distinguishes true local networking from other kinds of sharing (e.g. via a switch or multiplexer). Networked micros can be used to build multiuser systems (with one micro per user) traditionally handled by minicomputers, but with the major advantage that initial cost is low and the system can easily expand to handle increased loads. Unlike a centralized system which has a relatively fixed processing and memory capacity, with a network of micros, processing power and memory capacity increase linearly as users are added. The other major advantage of micros is the large pool of application packages available. Their availability is also directly related to the low cost of the development hardware; i.e. the microcomputer.

PCnet SYSTEM OVERVIEW

PCnet was developed to achieve the benefits described above. Since it was developed specifically for the IBM Personal Computer and the MS-DOS operating system, it offers better features and is more efficient than more general purpose "connect to anything" networks. PCnet can interconnect up to 64,000 PCs on a network, although at present only one cable per network is supported. This limits the maximum number to that supportable by the cable bandwidth. Refer to the Technical Reference section for more details.

PCnet Hardware

The PCnet hardware consists of a single slot PCnet Adapter board that plugs into each networked IBM PC. On the back of this board is a BNC type connector which plugs directly into the network cable via an inexpensive (passive) tap. The network cable is a standard 75 ohm cable-TV type coaxial cable that runs in a single line throughout the area where the networked PCs are installed. (This is known as a distributed bus topology). The cable can run up to 7000 feet allowing an entire work area to be "pre-wired" and PCs to be added to the network or moved within the networked area very easily; hooking up to the cable is as simple as plugging in the power.

The PCnet Adapter uses proprietary CSMA/CD circuitry to share the cable bandwidth among networked PCs. High speed operation is provided by a trasmission speed of approximately 1 Megabit per second, and the use of the PC's DMA (Direct Memory Access) capabilities.

PCnet Software

Each PCnet Adapter comes with software that integrates the network into MS-DOS. This MS-DOS interface is designed so that standard single user PC applications can use the network without change, and more advanced multiuser systems can be developed from single user systems with only minor modifications.

The three main functions of the MS-DOS interface are 1) disk sharing, 2) file locking, and 3) PC sharing (multi-tasking).

Disk Sharing. Disk sharing allows PCs t share hard disks installed in other PCs. Thi helps solve one of the major PC shortcoming - the lack of storage capacity. The shared d networked disks appear to be locally at tached; for example if a PC has one diskett drive and shares a hard disk via the network the user can access the local floppy as driv "A:", and the shared disk as "B:", "C:", etc. B changing the default drive to a shared driv (i.e. typing b: to get B> prompt), the user ca execute programs, store data, etc. directly o the networked drives. The mapping of loca drive letters (A, B, etc.) to local and share drives is totally flexible, so that the A: driv does not have to correspond to diskette driv number 0.

This sharing is immediately useful for multi-PC installation in many ways. First provides each user with the capacity ar speed of a hard disk at lower cost than th hard-disk per user alternative. Second, simplifies the backup problem - only the F with the shared disk need be backed up, ar the one backup can cover all users' dat Third, each user PC only needs one disket drive to perform the initial system boo Finally, it allows users to examine other use data files, and transfer files between share and local (floppy) storage. (Note that user fi protection is provided - refer to technic sections).

The disk sharing interface was designed f compatibility with all exisiting and future IB compatible hard disks, and has been tested su cessfully with DAVONG, QCS, TALLGRASS ar other drives.

File Locking. In order to implement a mult user, multi-PC application that shares com mon data files, there must be a mechanism ensure that common files are only accesse by one user at a time. Since MS-DOS does n currently support file locking, the MS-DO interface includes function calls to lock ar unlock files by name or by name and recor

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number. The lock call performs a slow loop waiting for the lock to be free before returning.

Using these calls it is relatively simple to convert a single user application to multiuser as follows. First find those sections in the source that modify a common file or files. Then insert a lock function call for all accessed files before the access, and an unlock call afterwards. Then run the modified application in each PC. If two PCs try to modify a common file at the same time, one will simply wait until the other is finished before proceeding. This is the same principle used in all large multiuser systems. (Note that flexibility is provided if the application wants to do something while waiting for locked files - refer to the Technical Reference section.)

PC Sharing (MultiTasking). In order to create a truly distributed processing system with PCnet and MS-DOS, there must be a way to share expensive resources such as printers, communications lines, etc. and to perform multitasking. The MS-DOS interface does this by a feature called "remote execution". This allows a user on one PC to run a command on another PC as if the command had been entered on that PC's keyboard. After the command executes, the user is informed by a short beep on his or her PC. Thus one PC with specialized peripherals can act as an "execution server" for other PCs and can print files, assemble programs, format text, etc. while the user is performing other work. Software compatibility is guaranteed, and any hardware that is plug compatible with the PC is sharable. (For more complete details of this function refer to the Technical Reference section).

Remote execution is also useful for multi-PC applications which can be split into data entry and update/report program sections. User PCs can then run the data entry programs and submit remote commands to do the updating and report generation. If certain programs in an application system require large memory to run, running them exclusively in a common PC with a full memory complement can reduce the total system cost.

• PCnet APPLICATION EXAMPLES

Shared PC Word Processing System

This example describes a four user word processing system that shares a hard disk, and both letter and draft quality printers. The word processor provides a full screen editor and uses embedded commands in the text for formatting control. A separate formatting program is used to print the edited text. In this example it is assumed that a DAVONG or similar hard disk unit is used that allows the hard disk to be split into multiple volumes.

The system uses five PCs: one acts as a shared printer/formatting station while the other four are used by operators to input and modify stored text. The shared PC contains a diskette drive, a fixed media hard disk unit (e.g. 12 Mbyte), and a disk cartridge unit (e.g. 5 Mbyte) for backup. The hard drive is formatted into 5 volumes with 2.5 Megabytes for each user (approx. 1600 pages). It also contains printer ports to which the printers are attached. The volume to disk mapping on the shared PC is as follows:

Volume	Drive	Contents
A:	Fixed, 2Mbyte	Common programs including the full screen editor and formatter. Read Only by all user PC's.
B:	Fixed, 2.5Mbyte	Read/Write file storage for user #1.
C:	Fixed, 2.5Mbyte	Read/Write file storage for user #2.
D:	Fixed, 2.5Mbyte	Read/Write file storage for user #3.
E:	Fixed, 2.5Mbyte	Read/Write file storage for user #4.
F:	Cartridge, 5Mbyte	Used exclusively for backup; can backup two users at a time.
G:	Floppy	Used to boot and copy programs to program drive A:

Each operator's PC is configured with only one diskette drive (used to boot the system). These PC's have a volume to disk mapping as follows:

Volume	Drive	Description
A:	Network Shared Drive A:	volume containing read only programs.
B:	Network Shared Drive X:	volume assigned as read/write storage for this user.
C:	Local Floppy Drive	volume for local storage.

The operator's procedure is as follows. The default drive is A: so that all programs requested are retrieved from the shared program volume. Drive B: is used to store the text being worked on. When the text is ready for formatting and draft printing, the operator issues a remote command to the shared PC which invokes the formatting program and sends the output to the fast draft printer. During formatting and printing the operator is free to begin on another document. Another remote command is used to format and print on the letter quality printer. Backup is done each day by one person using two cartridges, one per two users.

Mainframe Program Development

Many large mainframes are not well suited to interactive program development (for example on IBM mainframes, the TSO system is very inefficient). They lack good interactive full screen program editors and often provide poor response when heavily loaded. An alternative is to use PCs to write programs and review results. However, mainframe communications lines are expensive and would be poorly utilized if one line had to be provided per PC.

PCnet can provide the following solution. Configure a "shared" PC with a hard disk and the communication line to the mainframe, and link "user" PCs to it via PCnet. The user PCs need only one diskette drive since they will share the hard disk. Assuming a file transfer program exists to transfer programs and output to and from the mainframe, install this program on a hard disk. Users then do program editing on their own PC, and request its transfer and execution on the mainframe via a "remote command" to the shared PC. After the program has been executed, the user again commands the shared PC to transfer the output file into the hard disk, reviews it and modifies the program under development accordingly.

To make this example more concrete, assume that the hard disk can be split into a number of volumes starting with A:. A: will be used to hold all common programs and would be read-only by all user PCs. Volumes B: and up would each be assigned with read/write permission to different users for program development. Each user therefore sees following drive layout:

A:—shared hard disk (read only) containing editors, etc.
B:—shared hard disk (read/write) for data storage.
C:—local floppy drive.

PCnet SYSTEM TECHNICAL REFERENCE

This section describes the features of PCnet in greater technical detail. The description covers Version 1.0 of the PCnet System and MS-DOS interface.

HARDWARE SPECIFICATIONS

PHYSICAL.	Fits in a single IBM PC I/O Slot. Components extend a maximum of .5 inches above PC board.	
POWER.	+5 VDC maximum	1.00 Amps
	+12 VDC maximum	0.15 Amps
	-12 VDC maximum	0.10 Amps
ENVIRONMENTAL.	Operating Temperature 0	C.
	Storage Temperature	
	Relative Humidity 0 to (non-condensing)	
PC INTERFACE.	Uses interrupt lines #3, #5. DMA channel #1. I/O port address hex 380 - 38F inclusive.	

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Introducing Community Microcomputing. It unites personal computers to form a sophisticated business system.

Nestar's PLAN for complete information handling.

To make the concept of Community Microcomputing work, Nestar has developed PLAN 4000,™ our third-generation Personal Local Area Network. PLAN 4000 unites Apple II, Apple ///, and IBM Personal Computers with other system elements to form a complete, flexible information system.

The system's baseband, token-passing protocol approach makes PLAN 4000 low cost and contention-free. The system follows the structure of the ISO seven-layer model and implements layers one and two of the ARCnet™ standards and layers three and four of the Ethernet™ standards. The result is ease of interconnections and adaptation of existing systems and software. Transmission rates of 2.5 megabits/second make PLAN 4000 fast enough for the 16 and 32 bit workstations of the future. And Nestar's extensive field-proven software makes it powerful and reliable. As many as 255 personal computers can be linked together in an arbitrary topology with distances over 4 miles between any two stations.

Complete communications.

Nestar's File Transfer Server, combined with the MESSENGER™ electronic mail program, allows community members to exchange files and messages between their workstations and other Nestar PLAN 4000 systems or remote workstations. A 3270 Emulator Server gives each workstation the best features of an IBM 3270. A 3780 Emulator Server gives you batch-mode access to the full power of an IBM mainframe. A Gateway Server permits real-time access to other Nestar networks. A Telex Server allowing access to Telex lines from each workstation is also available.

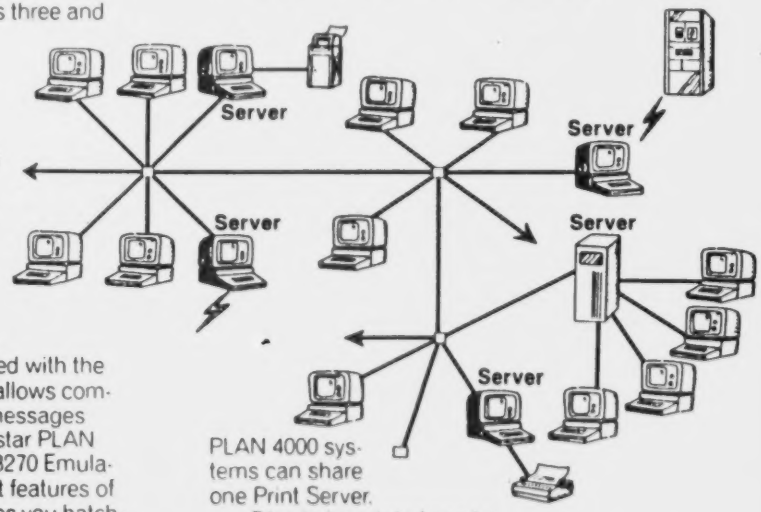
Many more communications servers are now being developed.

Complete file handling.

The File Server handles all access to shared mass storage and system backup. Each File Server can support up to 548 megabytes of formatted storage on 60 and 137 megabyte hard disks. By using multiple File Servers, storage capacity can be expanded virtually indefinitely. System bac is provided through 20 or 45 megabyte streaming tape drives. The File Server supports a wide variety of popular operating systems in the workstations, extensive file management utilities, and some of the most comprehensive security options in the business.

Complete printing facilities.

Spooled system printing can be distributed using multiple Print Servers. Each Print Server can support as many as six printers of almost any type. Several



PLAN 4000 systems can share one Print Server.

Files to be printed can be queued, and you can specify printing priority, document appearance, the number of copies to be printed, and much more.

How to plan for our PLAN.

Call or write us today. We'll send you complete specifications on our PLAN 4000 System.

NESTAR

The First Source for Community Microc mputing.

Community Microcomputing, MESSENGER, and PLAN demarks of Nestar Systems, Inc. ARCnet is a trademark of Datapo Ethernet is a trademark of Xerox Corp.

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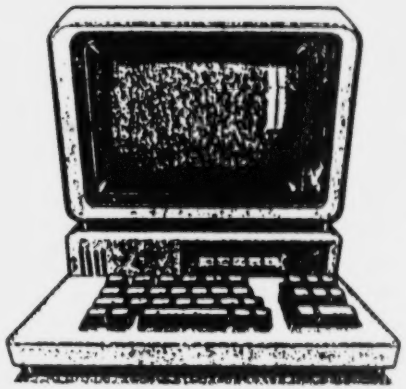

There's a new type of computer user. One who needs a new type of computer system.

This community of users needs both the desktop processing power of a personal computer and the access to shared resources that makes large-scale network systems so efficient as corporate information handlers.

Nestar is dedicated to providing system solutions to this group. We call what we do Community Microcomputing.

Community Microcomputing is more than just a group of PCs strung together with wire. It's a community of shared resources that can include personal computers, disk storage, printers, even an IBM mainframe.

This sharing of resources combines the advantages of distributed data processing with the advantages of personal computers. And it lets you spread the cost of higher-priced system elements to provide the most efficient and flexible solution to your information handling needs.

Community Microcomputing. The information handling system of the future. It's available today from Nestar.

NESTAR

Nestar Systems, Incorporated
2585 East Bayshore Road
Palo Alto, CA 94303
(415) 493-2223

Turn simple personal computers into a community of shared resources.

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The Novell Network Processor

- Attractive desk top case
- Modular growth to 24 Workstations
- Winchester disks up to 120 megabytes (unformatted)
- Spooling for up to five printers
- Novell Operating System CP/M® Compatible
- MC68000® 16-bit microprocessor
- Network uses standard four conductor shielded wire
- Up to 512 kilobytes parity protected memory

The Novell Network Processor (NEP) features the Motorola MC68000® 16-bit microprocessor. This allows NEP to use:

32-bit data and address registers
16 megabyte direct addressing range
56 powerful instruction types
14 addressing modes and much more

The Low-end Novell Network Processor (NEP) comes equipped with one high speed MUX board for control of up to six workstations, 128K of memory and one RS232C serial port for a shared printer. The High-end includes a 512K memory expander board, up to three more MUX boards to handle a total of 24 workstations, and a four port serial board for additional printers. Disk capacities range from 10 megabytes to approximately 120 megabytes (unformatted) of Winchester hard disk space. Each workstation is connected to the Network processor by using inexpensive four conductor shielded wire extending to 3000 feet in length.

The Novell Operating System (NEP/OS) is a sophisticated, multitasking software package that operates in the NEP. The operating system consists of procedures that handle the disk drives, printer spooling, real time clock, console, and CP/M® workstation requests. The workstation requests provide commands to insure data security and protection from deadlock within the network. Broadcasting and electronic mail allow inter-station communication. The Network Processor and the Network Operating System combine to provide each workstation with the ability to use currently available single user CP/M® software while offering all of the advantages of a true multi-user distributed processing environment. These features combine to make an extremely powerful and efficient system.

CP/M® is a registered trademark of Digital Research.
MC68000® is a registered trademark of Motorola Electronics & Communications, Inc.

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Specifications

Primary Processor

Motorola MC68000® microprocessor CPU with 128 kilobytes of memory. Includes two RS232C ports, one for the console and one for a printer.

Multiplexer (MUX) Board

Multichannel, microprocessor controlled network communications board providing facilities to connect up to six remote workstations.

Up to four separate MUX boards can be mounted in the Network Processor cabinet.

Memory

128 kilobytes of memory with future expansion of an additional 394 kilobytes of parity protected memory.

Performance attributes

Disk caching	Public and private files
Directory caching/hashing	Shared and non-shared files
Password protection	Message passing
	Mail system

Expansion of 4 additional RS232C ports is available.

Specifications subject to change without notice. (060182)

Novell Network Processor Model 2216

Overall Size

7 Inches (17.8cm) high, 19 inches (48.3 cm) wide, 19 inches (48 cm) deep

Weight

35 pounds (15.9 kg)

Finish

Textured

Operating Environment

50° F to 122° F (10° C to 50° C) in atmosphere of from 30% to 80% relative humidity (non-condensing). Maximum altitude: 10,000 feet (3050 meters).

Operating Environment

Power: 345 Watts

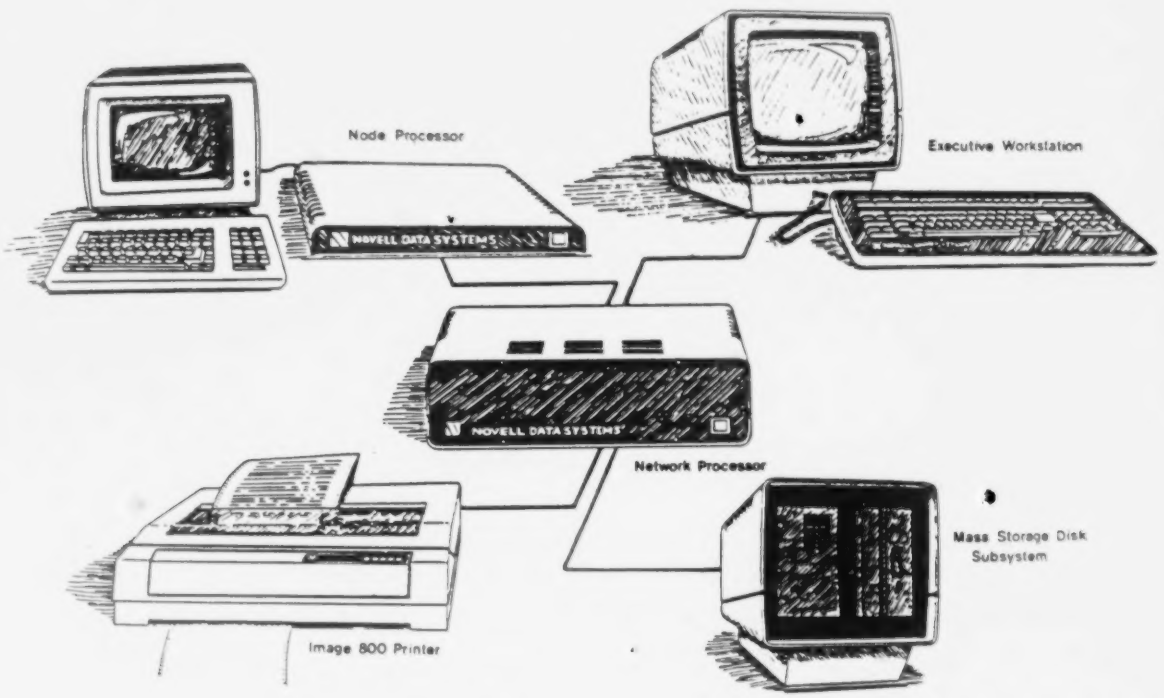
Voltage: 115 Volts AC (plus or minus 10%), 50 Hz or 60 Hz
220 Volts AC (plus or minus 10%), 50 Hz or 60 Hz

Network Cabling

4 Conductor shielded wire.

Standard lengths: 30, 50 and 100 feet (9, 15 and 30 meters)

Cables can be ordered in lengths extending to 3,000 feet (900 meters)



®MC68000 is a registered trademark of Motorola Electronics & Communications, Inc.

NOVELL
DATA SYSTEMS
1170 NORTH INDUSTRIAL PARK DRIVE
OREM UTAH 84057

Telephone: (801) 226-8202 (800) 453-1267

Telex: 669 401 AIRS COURS PHO

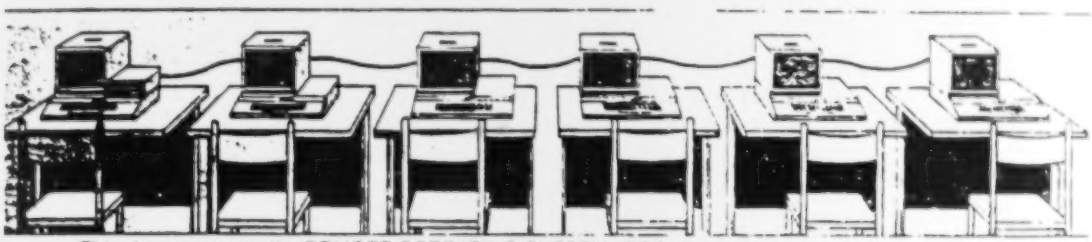
A Safeguard Scientifics Company

THE R.O.S. NETWORK

for the Apple II Computer

The difference between these two classrooms could save you $2,000*

This classroom uses a separate disk drive for every Apple II



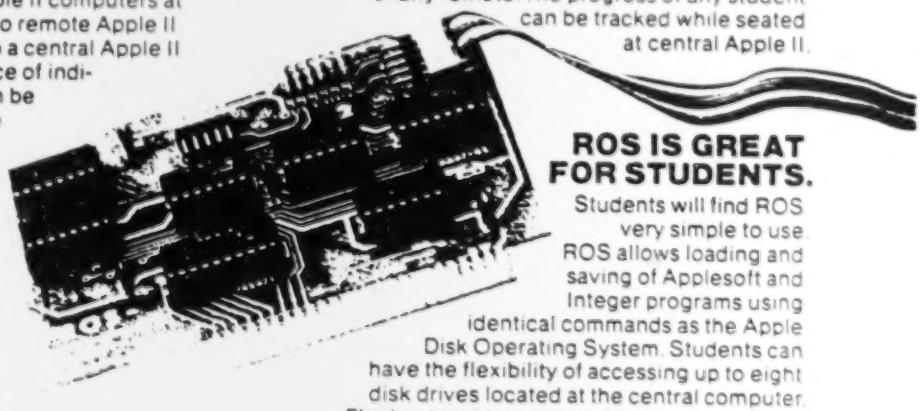
This classroom uses the REMOTE OPERATING SYSTEM (ROS) to provide disk storage for programs

ROS IS EASIER ON THE BUDGET.

ROS replaces floppy disk drives on up to 127 independently run Apple II computers at substantially lower cost. Two remote Apple II computers can be linked to a central Apple II disk system for half the price of individual disk drives. ROS can be expanded for less than one third the cost of an additional drive. The savings on four remotes could buy another Apple II and monitor.

ROS IS EASIER ON THE EDUCATOR.

ROS simplifies instruction when using more than one Apple II. One diskett can supply all programs to the remotes instead of loading multiple copies into each separate system. ROS also allows the central computer to monitor the activity of any remote. The progress of any student can be tracked while seated at central Apple II.



ROS IS GREAT FOR STUDENTS.

Students will find ROS very simple to use. ROS allows loading and saving of Applesoft and Integer programs using identical commands as the Apple Disk Operating System. Students can have the flexibility of accessing up to eight disk drives located at the central computer. The best part is more students can use a computer more often. ROS stretches your budget dollar further to buy more Apple II computers.

Features

- Password Protection
- 127 Remotes may be connected to Central
- Up to 8 Floppy Disk Drives on Central
- R.O.S. uses identical command words to Apple DOS
- Auto start compatible for turn key system start up
- Special R.O.S. "FEED" command for simultaneous loading a program
- Special "WAIT" message tells the remote user when the network is busy
- Special "HELP" command provides user assistance
- Special error messages clarify network operation
- Complete listing of valid network commands displayed on remote at start up
  - LOAD program name, disk drive letter
  - SAVE program name, disk drive letter
  - VERIFY program name, disk drive letter
  - RUN program name, disk drive letter
  - INT (change to integer language)
  - FP (change to floating point language)
  - CATALOG, disk drive letter
  - KAT (special command) = quick reprint of last catalog
  - HELP (special command) = explanation of R.O.S. commands
  - FEED (special command) = receive program simultaneously
- Future expansion of system capabilities through software only
- Hard disk interface software available
- Central board may be installed in any slot, except 0
- 12,500 + baud rate transmission
- Full reset, dataline error, and system error recovery
- Complete "setup" software provided with system software

See the Remote Operating System at your Apple Dealer today

*Based on suggested retail prices as of July 1981

Apple and Apple II are Registered Trademarks of Apple Computer Inc

An intelligent subsystem from

SOFTDORKS INC.

14805 N. 73rd Street, Suite J
Scottsdale, AZ 85260 (602) 998-3986

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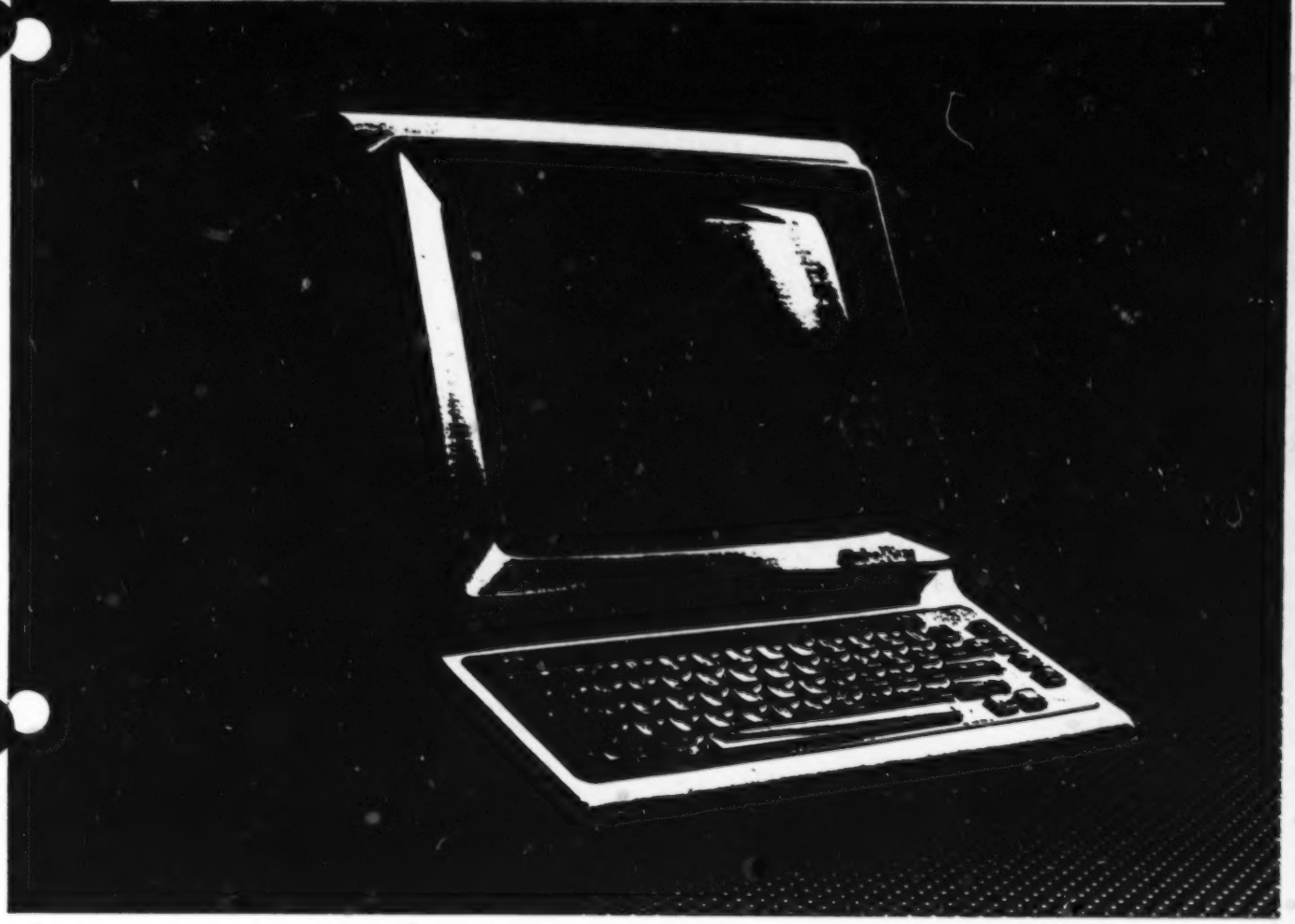
Tymshare

Personal Information Terminals

Scanset Models 410 and 415



Easy access to information and data is yours with Tymshare's Scanset—the quiet, compact, personal information terminal. Automatic dial* and automatic logon features allow computer access with just one or two keystrokes! And, these lightweight terminals take up less space than a typewriter. Because of their low cost, they are ideal for occasional and multiple-location use.

Scanset Model 415 is equipped with a modem for telecommunications. Scanset Model 410 connects directly to a computer. Both models can be used with most popular printers.

With either model of the Scanset, remote data access is easier than ever before.

Auto Dial, Auto Logon—Model 415 automatically dials up to 36 phone numbers; the first four numbers also provide auto logon capabilities. This terminal can also be used with a phone as a time-saving auto dialer for frequently called telephone numbers.

Both terminals automatically identify themselves to host computers when queried. Logon procedure is confirmed through video display and a self-contained speaker.

Programmable Function Keys—Six multi-function keys control 24 functions. Twelve functions are predefined and used to control terminal operation. The other 12 functions can be defined by the user for additional auto logon or data base access functions. For ease of use, labels for function keys are always displayed on the last line of the video screen.

SCANSET™

An information product from Tymshare

© 1982 Tymshare, Inc.

340(5 82)50M7186

Readability—For comfortable use, the flicker-free screen is set at an optimum viewing angle. A 9" diagonal CRT clearly displays 5x9 dot matrix characters on a P4 phosphor screen. Scanset features automatic scrolling from the bottom of the screen after the 24th line is completed. The screen is refreshed at the AC line rate; 625 lines are scanned with no interlacing.

Speaker—A self-contained speaker announces telephone conversation, carrier-wave signal, ringing/busy signal, and end-of-line signal. The volume is adjustable.

Graphic Characters—With their graphic character sets, both Scanset models can display simple forms and data plots. The basic character sets are ASCII Alphanumerics, Mosaic Graphics, and Supplementary Graphics.

Status Word—Depressing the STAT function key displays the status of the terminal on the screen. The status display allows the user to select from the keyboard: terminal and printer port speeds, tone or pulse dialing*, 7- or 8-bit data word size, parity, screen brightness, speaker loudness, column beep, cursor control, return key, half or full duplex, scroll, x on/x off, and 40- or 80-character line size.

Reliability—Scansets are designed to meet the same rigorous demands that are placed on telephone and telecommunication equipment. Because of this rugged reliability, they are warranted against defects in parts and workmanship for one full year.

Both terminals meet FCC Parts 68 and 15 standards, DHHS (X-ray emissions) standards, and are UL certified.

Specifications

Characters	5x9 dot matrix in a 6x10 dot matrix cell.
Format	24 lines x 80 characters, or 24 lines x 40 characters, selectable from keyboard; a 25th line is used for function key labels.
Character Set	ASCII Alphanumerics, Mosaic Graphics, and Supplementary Graphics character sets.
Keyboard	68-key attached keyboard, set at optimum height and angle for ease of use.
Auto Dial	Model 415 automatically dials up to 36 telephone numbers; first four numbers also are provided auto logon capabilities. Tone or pulse dialing, keyboard selectable.
Baud Rates (bps)	Terminal: 75, 150, 300, 1200. Modem*: 300. Printer port: 150, 300, 1200, 2400. DC-1 and DC-3 protocols (x on/x off), keyboard selectable.
Parity	Even, Odd or None, keyboard selectable.
Communications	Bell 103 full duplex modem* for 300 baud telecommunications. Uses DC-1 and DC-3 protocols (x on/x off). Full/half duplex, keyboard selectable. RS 232C for direct connection to host computer†.
Interface	RJ-11C jack for 300 baud, full duplex telecommunications*, or RS 232C†. RS 232C electrical characteristics peripheral port connector with male RS 449 pin configuration.
Memory	2K display, 1K CMOS RAM
Dimensions	9½"H x 10¼"W x 14½"D.
	12 lbs (5.5 kg).
	103.5vac to 126.5vac, 2 amps, 35 watts max. 6' grounded line cord supplied.

* Model 415 only † Model 410 only

TYMSHARE®
Equipment Product Marketing
20705 Valley Green Drive
Cupertino, CA 95014

DATALINK™

Compact, Lightweight, Inexpensive Telecommunications Terminal

- Communicates with any computer database from any standard telephone.
- Truly portable—only 6-3/4" x 3-9/16" x 1-5/8"—weighs 13 oz.
- Full typewriter-style keyboard—Six non-alphanumeric function keys for easy operation.
- Standard modular handset plug. Connects directly with the widest variety of telephones available today.
- Built-in, modem selectable baud rates: 110 for continuous reading, 300 for storage or output to a printer or CRT.
- Connects with auto-answer modems.
- Operates on batteries or AC (with adapter).
- 16 character, non-ghosting green flourescent display, visible in any lighting condition.
- Applications include sales information systems, order entry, electronic banking, on-line information services, and message switching.

AXLON PLUS PERFORMANCE SERIES™

Axlon, Inc.
70 Daggett Drive
San Jose, CA 95131
(408) 730-0216

SPECIFICATIONS

Display — Up-tilted, non-ghosting flourescent green with fast refresh.

Receive operations — 16 characters; scrolls from right to left in "ticker" fashion.

Transmit operations — 16 characters; displays left to right for 16 characters, then scrolls to the left.

Memory Size (buffer)

Receive — Last 240 characters are held in memory (wraparound repeat and review via scroll key).

Transmit — Last 16 characters sent are displayed while sending, or upon request in receive mode.

Display Size — 1/4" x 3-1/2"

Character Size — 1/4" x 1/8"

Character Set — 64 upper-case ASCII characters on transmit; upper-case characters on receive (lower-case characters automatically translated to upper-case).

Communications/Modem Operations — Built-in originate only modem connects via standard modular handset cord; 110/300 baud speed, keyboard selectable; Bell 103 compatible; 10-unit code; one start bit, eight data bits, one stop bit, no parity; ASCII code; full or half duplex environment.

Keyboard — 43 tactile keys with audio feedback arranged in standard "QWERTY" layout (includes SHIFT, SCROLL, ENTER, RETURN/CARRIAGE RETURN-LINE FEED, ESCAPE, CONTROL, LOCAL CLEAR and BACK SPACE, which generates an ASCII delete character and erases the previous character on the display).

Control Character Indicators — Escape = ($), Control = ( ).

Output Port — RS232C compatible interface built-in.

Power (recharger/adapter provides complete recharge in 36 hours) — Four (4) replaceable "AA" nickel cadmium (NI-CAD) batteries (not included), good for one hour constant use before recharging or four (4) replaceable alkaline batteries good for four hours constant use (not included); alternatively uses UL approved recharger/adapter.

Weight — 10 ounces without batteries, 13 ounces with rechargeable NI-CAD batteries.

Dimensions — 1-5/8" (H) 3-9/16" (W) 6-3/4" (L).

Warranty — 90 days from date of shipment to end-user.

Service Contract — Optional annual service contract available after expiration of warranty.

OPTIONAL EQUIPMENT SPECIFICATIONS

Television Video Display Interface — 32 characters by 16 lines; "smart" logic display prevents broken words at the end of a line; attaches to VHF terminals of television and plugs into DATALINK output port; weighs less than a pound; cord length is six feet; 2K wraparound memory buffer allows scrolling through the last four screens of data received; AC adapter included.

Acoustic Coupler Interface — Soft rubber adapter cups provided for pay telephones and other non-modular telephones; snaps on to mouthpiece and earpiece for consistent and secure operation; powered from terminal; weighs less than a pound; attaches to DATALINK modular jack connector.

40 character Terminal Line Printer — Includes cable and attaches to output port.

BRS AFTER DARK

BRS/AFTER DARK DATABASES AVAILABLE NOVEMBER, 1982

DATABASE	PRODUCER	DESCRIPTION	PRICE PER HOUR
SCIENCES/MEDICINE			
BIOSIS Previews	BioSciences Information Service	Biological Sciences	$13.00
Chemical Abstracts	Chemical Abstracts Service	Chemistry	15.00
Health Planning and Administration	National Library of Medicine (NLM)	Health Economics, Administration and Planning	5.00
Medlars	National Library of Medicine (NLM)	Medicine, Nursing, Dentistry	10.00
Pre-Med	Bibliographic Retrieval Services	Current Clinical Medicine	5.00
BUSINESS/FINANCIAL			
ABI/INFORM	Data Courier, Inc.	Business	15.00
Management Contents	Management Contents, Inc.	Business	14.00
Patdata	Bibliographic Retrieval Services	All Patents Registered Through U.S. Patent Office Since 1975	5.00
REFERENCE			
Books In Print	R.R. Bowker	U.S. Books In Print	14.00
EDUCATION			
Bilingual Education Bibliographic Abstracts	National Clearinghouse for Bilingual Education	Bilingual/Bicultural Education	5.00
ERIC—Education Resource Information Center	National Institute of Education	Education	5.00
Exceptional Child Education Resources	Council for Exceptional Children	Exceptional Child Education	11.00
School Practices Information File	BRS Education Service Group	School Practices	6.00
SOCIAL SCIENCES/HUMANITIES			
Family Resources	National Council on Family Relations	Marriage and Family Literature	12.00
National Information Sources on the Handicapped	Clearinghouse on the Handicapped	Physical Disabilities and Related Information	5.00
National Rehabilitation Information Center	National Rehabilitation Information Center	Rehabilitation Literature	5.00
Pre-Psyc	Bibliographic Retrieval Services	Current Clinical Psychology	5.00
PsychINFO	American Psychological Association	Psychology	14.30

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(518) 783-1161

BRS/AFTER DARK...

Easy To Access, Inexpensive To Use

Below is a typical search of a database as it would appear on your terminal. The various codes are explained in the marginal notes.

TYPE IN LABEL FOR DATABASE DESIRE_: mgmt

You select desired database

System describes selected database.

THE BRS/MANAGEMENT CONTENTS DATABASE CONTAINS INFORMATION ON BUSINESS, MANAGEMENT, ECONOMICS, FINANCE, ACCOUNTING, LAW, INDUSTRY AND MARKETING FROM BOOKS, PERIODICALS AND REPORTS AS WELL AS FILMS, SLIDES AND GENERAL NON-PRINT MEDIA. PRODUCED BY MANAGEMENT CONTENTS, INC., IT IS UPDATED MONTHLY AND IS A WELL-KNOWN AND COMPREHENSIVE COLLECTION OF INFORMATION FROM THE U.S., CANADA AND GREAT BRITAIN DATING FROM 1974.

System asks for your first inquiry (S1); answers with the number of items found (A1).

TYPE IN SEARCH TERMS
S1 cash management accounts
A1 6 ITEMS FOUND

You enter desired search terms.

System requests your instruction.

TYPE S TO CONTINUE SEARCHING, P TO PRINT ITEMS FOUND, M TO RETURN TO DATABASE MENU, OR O TO SIGN OFF_: p

You ask to print first item

1st item: Author, Title, Source

#1 AU Loomis, C.J.
TI The Fight For Financial Turf.
SO Fortune. Vol. 104, No. 13, Dec. 28, 1981, P. 54, 62+.

Descriptors (alternate search terms)

DE Banks-and-Banking. Legislation. Financial-Institution. Government-Regulation. Cash-Management.

Abstract

AB The financial world is in a state of unpredictable flux, as evidenced by a flurry of legislation aimed at regulating and deregulating the industry. Banking companies, brokerage firms and even formerly nonfinancial institutions are attempting to define their roles in the competitive action by buying up and invading the securities brokerage business. The brokerage business is seen as a particularly attractive pull as it suits the needs of many consumer savers. What has surfaced from all the transactions is a new savings hybrid — the Cash Management Account (CMA) — a system which offers tremendous customer appeal by allowing savings, check writing and loan opportunities from a single source. Many businesses jumped into marketing the CMA quickly, and are now lamenting their early action as the system is proving to be a consumer-attractive but institution-unprofitable albatross. It is clear that the balance between CMAs and money market fund opportunities is revolutionizing the financial world and dragging nonfinancial institutions quickly into the revolution.

System requests your instruction.

END OF ITEM. HIT ENTER KEY TO SEE NEXT ITEM, S TO CONTINUE SEARCHING, M TO RETURN TO DATABASE MENU, OR O TO SIGN OFF_: s

You decide to continue searching

TYPE IN SEARCH TERMS
S2 S1 and merrill lynch
A2 5 ITEMS FOUND

You ask to combine the Cash Management Account search (S1) with a Merrill Lynch search (S2) to retrieve articles about both.

TYPE S TO CONTINUE SEARCHING, P TO PRINT ITEMS FOUND, M TO RETURN TO DATABASE MENU, OR O TO SIGN OFF_: p

#1 AU Anon.
TI All They Want Is All Your Money.
SO Business Week, No. 2720, Dec. 28, 1981, P. 148-149.
DE Cash-Management. Investment. Banks-and-Banking. Brokerage.
AB Cash Management Accounts are proving to be popular with an increasing number of investors. In 1977, Merrill, Lynch, Pierce, Fenner & Smith Inc. originated the idea of a centralized asset account in which a computer moves cash around from checking account to money market mutual fund to brokerage at the investor's will. Bankers and VISA and MASTERCARD are planning similar accounts.

END OF ITEM. HIT ENTER KEY TO SEE NEXT ITEM, S TO CONTINUE SEARCHING, M TO RETURN TO DATABASE MENU, OR O TO SIGN OFF_ o

You sign off

BRS AFTER DARK

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BRS DATABASES AVAILABLE September, 1982

Each of the over 50 files available on BRS is structured for maximum searching efficiency on the most sophisiticated and flexible retrieval system on the market, BRS/SEARCH.

Selected for quality and wide appeal, the files cover a multi-disciplinary range of topics including business, the life and physical sciences, social sciences, and humanities. BRS also produces several unique and important databases which are highlighted in the list below.

In addition to the publicly available files on BRS, the INFORMATION BANK-II is available to BRS Users through special arrangements with the New York Times Information Service.

SCIENCES/MEDICINE

DATABASE	LABEL	PRODUCER	DESCRIPTION
AGRICOLA	CAIN	National Agricultural Library (NAL)	Agriculture
BIOSIS PREVIEWS	BIOL	BioSciences Information Service	Biological sciences
CA SEARCH	CHEM	Chemical Abstracts Service	Chemistry
CA SEARCH TRAINING	CAST	Chemical Abstracts Service	Chemistry
COMPENDEX	COMP	Engineering Information, Inc.	Engineering
HEALTH PLANNING AND ADMINISTRATION	HLTH	National Library of Medicine (NLM)	Health economics, administration and planning
INSPEC	INSP	Institute of Electrical Engineers, London, England	Engineering, physics, and computer science
MEDOC	MDOC	Eccles Health Sciences Library, University of Utah	Government documents in health sciences
MEDLARS-ON-LINE (MEDLINE)	MESH	National Library of Medicine (NLM)	Medicine, nursing, dentistry
NTIS	NTIS	National Technical Information Service	Government reports, all areas
PRE-MED	PREM	Bibliographic Retrieval Services	Current clinical medicine
SSIE	SMIE	National Technical Information Service	Physical, social, engineering and life sciences

BUSINESS/FINANCIAL

DOW JONES NEWS	DOWJ	Dow Jones and Company, Inc.	Business and financial news
FINTEL: FINANCIAL TIMES OF LONDON	FNTL	Predicasts, Inc.	Business
HARFAX INDUSTRY DATA SOURCES	HARF	Harfax Database Publishing	Industry data
HARVARD BUSINESS REVIEW/ONLINE	HBRO	John Wiley and Sons (electronic publisher)	Business and management
INFORM	INFO	Data Courier, Inc.	Business
MANAGEMENT CONTENTS	MGMT	Management Contents, Inc.	Business
NEW YORK TIMES INFO BANK—II*	NYTS	New York Times	Current news information
PATDATA	PATS	Bibliographic Retrieval Services	All patents registered through U.S. Patent Office
PREDICASTS: PROMT/ F&S INDEX/HISTORICAL ANNUAL TIME SERIES/ FORECASTS	PTSP/ PTSI/ PTSH/ PTSF	Predicasts, Inc.	Business and economics

*Requires subscription via New York Times Information Service

REFERENCE

AMERICAN MEN AND WOMEN OF SCIENCE	MWSC	R.R. Bowker	Directory of scientists
BOOKS IN PRINT	BBIP	R.R. Bowker	U.S. books in print
BOOKSINFO	BOOK	Prodart, Inc.	800,000 books in print
CALIFORNIA UNION LIST OF PERIODICALS (CULP)	CULP	California Library Authority for Systems and Services (CLASS)	California periodicals holdings
DISSERTATION ABSTRACTS	DISS	University Microfilms	Multi-disciplinary
GPO MONTHLY CATALOG	GPOM	U.S. Government Printing Office	Government publications
ULRICH'S INTERNATIONAL	ULRI	R.R. Bowker	Directory of periodicals
USBE MOST-AVAILABLE TITLES	USBE	Universal Serials and Book Exchange, Inc.	10,000 serial titles available for distribution

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DATABASE	LABEL	PRODUCER	DESCRIPTION
EDUCATION			
BILINGUAL EDUCATION BIBLIOGRAPHIC ABSTRACTS	**BEBA**	National Clearinghouse for Bilingual Education	Bilingual/bicultural education
ERIC	**ERIC**	National Institute of Education	Education
EXCEPTIONAL CHILD EDUCATION RESOURCES	**ECER**	Council for Exceptional Children	Exceptional child education
NIMIS	**NIMI**	National Center for Educational Media and Materials for the Handicapped	Instructional materials for education of the handicapped
RESOURCES IN VOCATIONAL EDUCATION	**RIVE**	National Center for Research in Vocational Education	Vocational education
SCHOOL PRACTICES INFORMATION FILE	**SPIF**	BRS Education Service Group	School practices
SOCIAL SCIENCES/HUMANITIES			
ALCOHOL USE/ABUSE	**HAZE**	University of Minnesota College of Pharmacy	Alcoholism
DRUGINFO	**DRSC**	University of Minnesota College of Pharmacy	Drug abuse
FAMILY RESOURCES	**NCFR**	National Council on Family Relations	Marriage and family literature
MLA BIBLIOGRAPHY	**MLAB**	Modern Language Association of America	Language, linguistics and folklore
NARIC	**NRIC**	National Rehabilitation Information Center	Rehabilitation literature
NATIONAL INFORMATION SOURCES ON THE HANDICAPPED	**NISH**	Clearinghouse on the Handicapped	Physical disabilities and related information
NIMH	**NCMH**	National Institute of Mental Health	Mental health and related information
PUBLIC AFFAIRS INFORMATION SERVICE	**PAIS**	Public Affairs Information Service	All social sciences
PRE-PSYC	**PREP**	Bibliographic Retrieval Services	Current clinical psychology
PsycINFO	**PSYC**	American Psychological Association	Psychology
RELIGION INDEX	**RELI**	American Theological Library Association	Religion
SOCIAL SCIENCE CITATION INDEX	**SSCI**	Institute for Scientific Information	Social science
ENERGY/ENVIRONMENT			
EIS: DIGESTS OF ENVIRONMENTAL IMPACT STATEMENTS	**EIST**	Information Resources Press	Environment
ENERGY DATABASE	**DOED**	U.S. Department of Energy	Energy and environment
ENERGYLINE	**EICI**	Environment Information Center	Energy
ENVIROLINE	**EIVI**	Environment Information Center	Environment, conservation
FEDEX: FEDERAL ENERGY DATA INDEX	**FEDE**	U.S. Department of Energy	Energy statistics
POLLUTION ABSTRACTS	**POLL**	Cambridge Scientific Abstracts	Pollution
BRS SPECIAL FILES			
BRS BULLETIN ONLINE	**BULL**	Bibliographic Retrieval Services	BRS BULLETIN online
CROSS	**CROS**	Bibliographic Retrieval Services	Cross-file searching
FILE	**FILE**	Bibliographic Retrieval Services	BRS database directory
MESSAGES	**MSGS**	Bibliographic Retrieval Services	Electronic message switching
NEWS	**NEWS**	Bibliographic Retrieval Services	System update file
TERM	**TERM**	Bibliographic Retrieval Services	Social science thesauri

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THE SOURCE RATES & FEES

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$100 Registration & Guarantee

This one-time fee covers registration, account set-up, ID and password assignment, *User's Manual* and *SOURCE Digest*. If you are dissatisfied, this registration fee may be refunded upon written request made within 30 days of subscribing. You will be responsible only for usage and other charges incurred.

Connect Time

These charges are for the amount of time you are actually connected to THE SOURCE℠. Time is computed to the nearest minute as recorded by computer.

	Services	Weekday 7 am-6 pm	Evening, Weekends & Holidays	Midnight to 7 am daily
THE SOURCE 1,200 information and communication services	300 baud service	$18.00/hr	$ 5.75/hr	$ 4.25/hr
	1200 baud service	25.00/hr	9.00/hr	6.00/hr
SOURCE • PLUS value – added information services	300 baud service	30.00/hr	15.00/hr	10.00/hr
	1200 baud service	40.00/hr	25.00/hr	15.00/hr

Storage

These rates are for storage of personal or business files on THE SOURCE computers. One block equals 2,048 characters.

Storage Rate for Personal Files		Block equals 2,048 Characters
First 1-10 blocks	=	50¢/block/month
Then: 11-99	=	20¢/block/month
Then: 100-999	=	15¢/block/month
Then: 1,000-9,999	=	10¢/block/month
Then: 10,000-99,999	=	5¢/block/month

Minimums

These are minimum monthly charges for THE SOURCE services.

$1	For account maintenance (2 storage blocks)
$9	Usage. (If you use less than $9 in connect time, you will be billed $9.)
25¢	Minimum connect fee each time you access THE SOURCE.

Miscellaneous

- Holiday rates are effective New Year's Day, Washington's Birthday, 4th of July, Memorial Day, Labor Day, Thanksgiving Day and Christmas.
- For rates other than continental U.S., contact THE SOURCE. Subscribers are responsible for telephone charges.
- Payments must be in U.S. dollars.
- Connect time charges are calculated as of *your* local time.
- System is down from 4-6AM EST for updating of data base and maintenance.
- Rates are subject to change with 30 days prior written notice.

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Bills will include all applicable taxes and charges for other items furnished by STC at the Subscriber's request, including but not limited to manuals, software, postage, and handling. STC may require business accounts to advance a non-interest bearing deposit which may be applied against all past-due balances. STC reserves the right to impose late charges on all accounts of 1½% per month on all unpaid balances 30 days past due.

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PC—112

THE SOURCE EQUIPMENT COMPATIBILITY REQUIREMENTS

PERSONAL COMPUTER	NECESSARY HARDWARE
Apple II Apple II Plus Apple III	Micromodem©, acoustic coupler or direct-connect modem, and communications card. Terminal software recommended.
Atari 400/800	Telelink cartridge. 850 Interface Module and acoustic coupler.
Commodore CBM	IEEE interface and acoustic coupler. Terminal software.
Heath/Zenith	Modem.
IBM Personal Computer	Modem and communications card.
Osborne I	Acoustic coupler with modifying circuit (available from manufacturer or Osborne Dealer). Terminal software recommended.
TI 99/4 and TI/99/4A	RS-232 interface, acoustic coupler, and Terminal Emulator I or II.
TRS-80 Model I	RS-232 board and expansion interface. Modem and cassette software.
TRS-80 Model II	Modem.
TRS-80 Model III	RS-232 board and modem.
VIC (Commodore)	IEEE interface and IEEE PET modem.
Xerox (SAM 820)	Modem and communications software.
Most CPM-based computers	Acoustic coupler or direct-connect modem.

Standard data terminals require only a standard RS-232 interface and a modem.

You also can use THE SOURCE on word/information processing equipment by adding an asynchronous communications package and modem.

Your hardware system must be set up to meet the following technical requirements:

300 or 1200 Baud
Full Duplex
No Parity
8 Bit ASCII Code
1 Stop Bit

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WOOLF SOFTWARE SYSTEMS

MOVE-IT™

A COMPUTER TO COMPUTER COMMUNICATION SYSTEM

COMMUNICATION WITH NON-"MOVE-IT" COMPUTERS

"MOVE-IT" allows your computer to communicate with any other computer, including other microcomputers, mini and mainframe computers as well as dial-up bulletin-board systems and information utilities. This makes MOVE-IT the ideal choice for transmitting programs, documents, sales records, and other data between offices, or other locations.

When talking to non-MOVE-IT equipped computers, the following features are supported:

- Full control over duplex and parity.
- Transfer of files to remote computers under 5 generalized protocols.
- Trapping of incoming data to disk.
- Printer control.
- Auto-line feed control.
- Compatible with DEC, IBM, and other mainframes.

ERROR-FREE TRANSFER BETWEEN MOVE-IT EQUIPPED COMPUTERS

When both machines are equipped with MOVE-IT, the user can perform error-free transfers for any type of file, including .COM and Visi-Calc files. These transfers can be accomplished even when the two computers are running different operating systems or disk formats. MOVE-IT employs a sophisticated error checking protocol—allowing transfers to be virtually error-free.

In addition, MOVE-IT supports all standard filename conventions including the '*,' allowing the user to transfer an entire disk of information in one command. Also, should the destination disk become full during transfer, the user can insert another disk into the drive and continue, thus allowing MOVE-IT to transfer files from a high-capacity disk to a lower capacity disk.

SUPPORT FOR AUTO-DIAL MODEMS

MOVE-IT supports a full-feature dialing system, compatible with most auto-dial 'smart' modems. The CALL command allows the user to dial any phone number either directly from the console or from a user-created directory on disk. Using this feature, the user can dial timesharing systems, information utilities, and bulletin-board systems specifying by name, rather than by phone number. In addition, the user can display the names in the directory at any time.

See Reverse Side

ON-LINE HELP FACILITY
Pressing the '?' key will display helpful information during the session. This allows MOVE-IT to be easily used by non-technical personnel.

EASE OF CONFIGURATION
Unlike other programs, MOVE-IT's configuration requires no special knowledge on the part of the user. Configuration data is provided in the manual for virtually every popular microcomputer and I/O board. After the configuration program customizes MOVE-IT for a particular I/O board or computer it is able to check the port to make sure it is fully functional. This ensures that the user has input the information correctly.

SUPPORT FOR MP / M AND OTHER MULTI-USER SYSTEMS
MOVE-IT allows the user to change 'user areas' on both the local and remote computer. In addition, the user is able to 'detach' MOVE-IT from the console in order to allow background operations.

UNATTENDED OPERATION
With MOVE-IT, transfers can be controlled from the operator's computer, allowing transfer to and from unattended computers.

DISPLAY OF LOCAL AND REMOTE DIRECTORIES
These commands enable the user to view both local and remote directories without returning to the operating system.

SEND A MESSAGE TO THE REMOTE COMPUTER'S CONSOLE
This can be used to request the remote operator to mount a different disk, or to log transfers on to the console.

DISPLAY THE NUMBER OF RETRIES PERFORMED DURING TRANSFERS
This allows the user to keep track of the quality of the phone line in use.

MOVE-IT is compatible with most computer systems with at least 32K of memory and at least 1 free RS-232 serial port, and is available in most popular formats.

The retail price for MOVE-IT is: $125 for all CP/M systems and $150 for all CPM/86 and MS-DOS systems, including the IBM PC.

The price includes the MOVE-IT disk, configuration utility, and User's Manual.

Give your computer the gift of communications...with MOVE-IT.

MOVE-IT is available from your local dealer or from:
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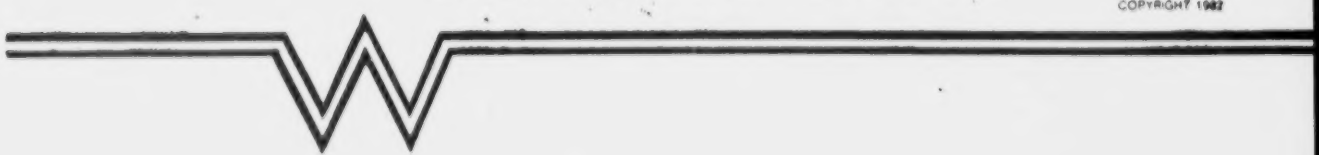
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